FES 08-44

FINAL

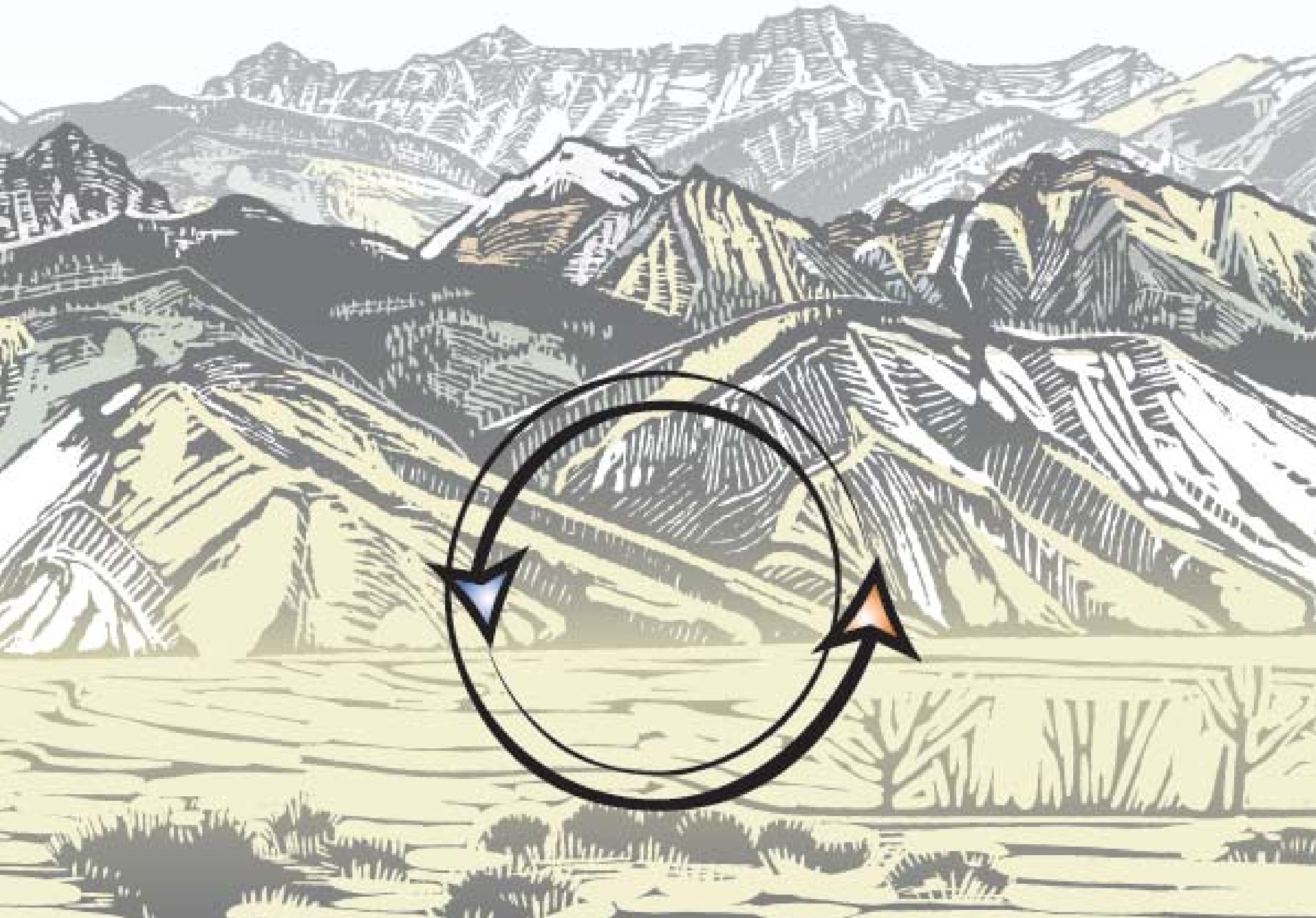
Programmatic Environmental Impact Statement for

Geothermal Leasing

in the Western United States

Volume I: Programmatic Analysis

October 2008



FES 08-44

FINAL

PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT FOR

GEOTHERMAL LEASING IN THE WESTERN UNITED STATES

VOLUME I: PROGRAMMATIC ANALYSIS

OCTOBER 2008

US DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

US DEPARTMENT OF AGRICULTURE
UNITED STATES FOREST SERVICE

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Washington, DC 20240
http://www.blm.gov

TAKE PRIDE IN AMERICA

OCT 0 3 2008

Dear Reader:

In August 2005, the U.S. Congress enacted the Energy Policy Act of 2005, Public Law 109-58, which recognizes the increasing demand for renewable energy and the need to facilitate leasing decisions for geothermal resources on public lands. Section 225 of this Act, titled "Coordination of Geothermal Leasing and Permitting on Federal Lands," requires that the Secretary of the Interior and Secretary of Agriculture establish a program for reducing by 90 percent the backlog of geothermal lease applications that were pending as of January 1, 2005. The Act also mandated that action be taken by August 8, 2010.

Enclosed is the Final Programmatic Environmental Impact Statement (FPEIS) for Geothermal Leasing for lands administered by the Bureau of Land Management (BLM) (termed "public lands") and the U.S. Forest Service (FS) (termed "National Forest System lands") that have geothermal potential in the 12 western states of Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. The BLM and FS jointly prepared the FPEIS in collaboration with the public; tribes; federal, state, and local agencies; universities and research institutions; stakeholder organizations; and industry.

The FPEIS evaluates various alternatives for allocating lands as being closed or available for leasing and analyzes stipulations to protect sensitive resources. The document describes the proposed amendments for 122 BLM-administered land use plans, also termed resource management plans (RMP), to adopt the allocations, stipulations, procedures, and Best Management Practices analyzed in the FPEIS. In addition, the FPEIS provides site-specific analysis for 19 pending geothermal lease applications for lands within 7 geographical areas that were filed prior to January 1, 2005.

The FPEIS and proposed RMP amendments have been developed in accordance with the National Environmental Policy Act of 1969 (NEPA), the Council on Environmental Quality's regulations for implementing NEPA (40 Code of Federal Regulations [CFR] 1500–1508), the Energy Policy Act of 2005, and applicable BLM and FS authorities. The three volumes of the FPEIS contain the programmatic analysis of geothermal leasing on BLM- and FS-administered lands, the proposed RMP amendments, site-specific analysis for the 19 pending lease applications, copies of the written comments received during the public review period of the Draft PEIS, and responses to these comments.

Because developing this and other alternative energy resources is of strategic importance in enhancing the Nation's domestic energy supplies, the Assistant Secretary, Land and Minerals Management, in the Department of the Interior is the responsible official for these proposed

BLM RMP amendments. The FLPMA and its implementing regulations provide land use planning authority to the Secretary of the Interior, as delegated to this Assistant Secretary. The Assistant Secretary, Land and Minerals Management will be approving these proposed RMP amendments. Therefore, there will be no administrative review (protest) of the proposed amendments under the BLM or Departmental regulations (43 CFR 1610.5-2). The Assistant Secretary, Land and Minerals Management, is the responsible official for the decision (Record of Decision) to be made with respect to the BLM RMP amendments.

As required by NEPA, the Environmental Protection Agency will publish a Notice in the *Federal Register* announcing the availability of the FPEIS for public review. The BLM is also providing a 60-day period for state governors to review the FPEIS and proposed RMP amendments for consistency with state plans. The BLM will wait until the end of this Governor's Consistency review period before signing and issuing the Record of Decision and approving the plan amendments.

The Record of Decision and approved plan amendments will be mailed or made available electronically to all who participated in the planning process. They also will be available to all parties via the Geothermal PEIS website (www.blm.gov/Geothermal_EIS) or by mail upon request.

Sincerely,

Dennis R Rosin

For: James L. Caswell
Director

Final Programmatic Environmental Impact Statement (PEIS) for Geothermal Leasing in the Western United States

Lead Agencies:	US Department of the Interior (DOI), Bureau of Land Management (BLM) US Department of Agriculture, Forest Service (FS)
Location:	Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming
Contacts:	Jack G. Peterson, BLM National Project Manager; (208) 373-4048, jack_g_peterson@blm.gov Ivette Torres, FS Liaison Specialist, Minerals and Geology; (703) 605-4792, ietorres@fs.fed.us
Project website:	www.blm.gov/geothermal_eis

Abstract:
In accordance with the Energy Policy Act of 2005, the project's goal are: (1) to make geothermal leasing decisions on pending lease applications submitted prior to January 1, 2005; and (2) to facilitate geothermal leasing decisions on other existing and future lease applications and nominations on the federal mineral estate in the western United States. Approximately 143 million acres of public lands administered by the BLM and 104 million acres of National Forest System (NFS) lands contain geothermal resources suitable for commercial electrical generation and direct uses, such as heating. Lands that are part of the National Park System and National Wildlife Refuge System are closed to geothermal leasing. The BLM and FS are proposing to allocate approximately 118 million acres of public lands and 79 million acres of NFS lands as open to geothermal leasing subject to existing laws, regulations, formal orders, stipulations attached to the lease form, and terms and conditions of the standard lease form. To protect special resource values, the BLM and FS have developed a comprehensive list of stipulations, conditions of approval, and best management practices. Under the proposed action, the BLM would amend 122 land use plans to adopt the allocations and the appropriate stipulations, and the FS would use the PEIS to facilitate subsequent consent decisions for any leasing on NFS lands. An alternative to the proposed action would limit the lands available for geothermal leasing to those that are in close proximity to existing transmission lines or those under development. The no action alternative would allow the processing of pending geothermal lease applications; however, they would be evaluated on a case-by-case basis and would require additional environmental review. Based on the analysis contained in the PEIS and public comments on the Draft PEIS, the BLM has selected Alternative B as the Preferred Alternative. The PEIS also provides site-specific analysis for 19 pending lease applications submitted prior to January 1, 2005, that are located in seven geographical clusters throughout Alaska, California, Nevada, Oregon, and Washington.

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Volume I: PROGRAMMATIC ANALYSIS

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LIST OF ACRONYMS

ACEC - Area of Critical Environmental Concern

ADR - Alternative Dispute Resolution

ANCSA - Alaska Native Claims Settlement Act

ANILCA - Alaska National Interest Lands Conservation Act

APD - Application for Permit to Drill

AUM - Animal Unit Month

BLM - United States Department of the Interior, Bureau of Land Management

BMPs - Best Management Practices

C - Celsius

CA - Conservation Agreement

CERCLA - Comprehensive Environmental Response, Compensation and Liability Act

CEQ - Council on Environmental Quality

CFR - Code of Federal Regulations

COAs - Conditions of Approval

CS - Conservation Strategy

CSU - Controlled Surface Use

CX (or CE) - Categorical Exclusion

DM - Departmental Manual

DNA - Documentation of Land Use Plan Conformance and National Environmental Policy Act (NEPA) Adequacy

DOI - Department of the Interior

DR - Decision Record (for an EA)

EA - Environmental Assessment

EFH - Essential Fish Habitat

EIS - Environmental Impact Statement

EPAct of 2005 - Energy Policy Act of 2005 (Public Law 109-58, August 8, 2005)

ESA - Endangered Species Act

F - Fahrenheit

FACA - Federal Advisory Committee Act

FLPMA - Federal Land Policy and Management Act of 1976 (43 United States Code 1701 et seq.)

FONSI - Finding of No Significant Impact

FS - United States Department of Agriculture, Forest Service

FWS - Fish and Wildlife Service

GIS - Geographic Information System

IBLA - Interior Board of Land Appeals

ITAs - Indian Trust Assets

IMP - Interim Management Policy

KGRAs - Known Geothermal Resource Areas

LAC - Limits of Acceptable Change

LUP - Land Use Plan

MFP - Management Framework Plan

MOU - Memorandum of Understanding

NEPA - National Environmental Policy Act of 1969

NFMA - National Forest Management Act of 1976

NFS - National Forest System

NGD - No Ground Disturbance

NHPA - National Historic Preservation Act

NLCS- BLM's National Landscape Conservation System

NMFS - National Marine Fisheries Service

NOA - Notice of Availability

NOAA - National Oceanographic and Atmospheric Administration

NOI - Notice of Intent

NPS - National Park Service

NRCS – National Resources Conservation Service

NREL - US DOE National Renewable Energy Laboratory National Renewable Energy Laboratory

NRHP - National Register of Historic Places

NSO - No Surface Occupancy

OSHA - Occupational Safety and Health Administration

OHV - Off-Highway Vehicle

PAC - Provincial Advisory Council

PEIS - Programmatic Environmental Impact Statement

PFYC – Potential Fossil Yield Classification

PM10 - Particulate Matter Less than 10 Micrometers in Diameter

PM2.5 - Particulate Matter Less than 2.5 Micrometers in Diameter

POD - Plan of Operation and Development

Ppm - Parts per Million

RAC - Resource Advisory Council

RFD - Reasonably Foreseeable Development

RMP - Resource Management Plan

RNA - Research and Natural Area

ROD - Record of Decision (for an EIS)

ROS - Recreation Opportunity Spectrum

ROW- Right of Way

SMS - Scenery Management System

T&E - Threatened and Endangered

TL - Timing Limitation

TMDL -Total Maximum Daily Load

US - United States

USC - United States Code

USDA - United States Department of Agriculture

US DOE - United States Department of Energy

US DOI - United States Department of the Interior

US EPA - United States Environmental Protection Agency

USGS - United States Geological Survey

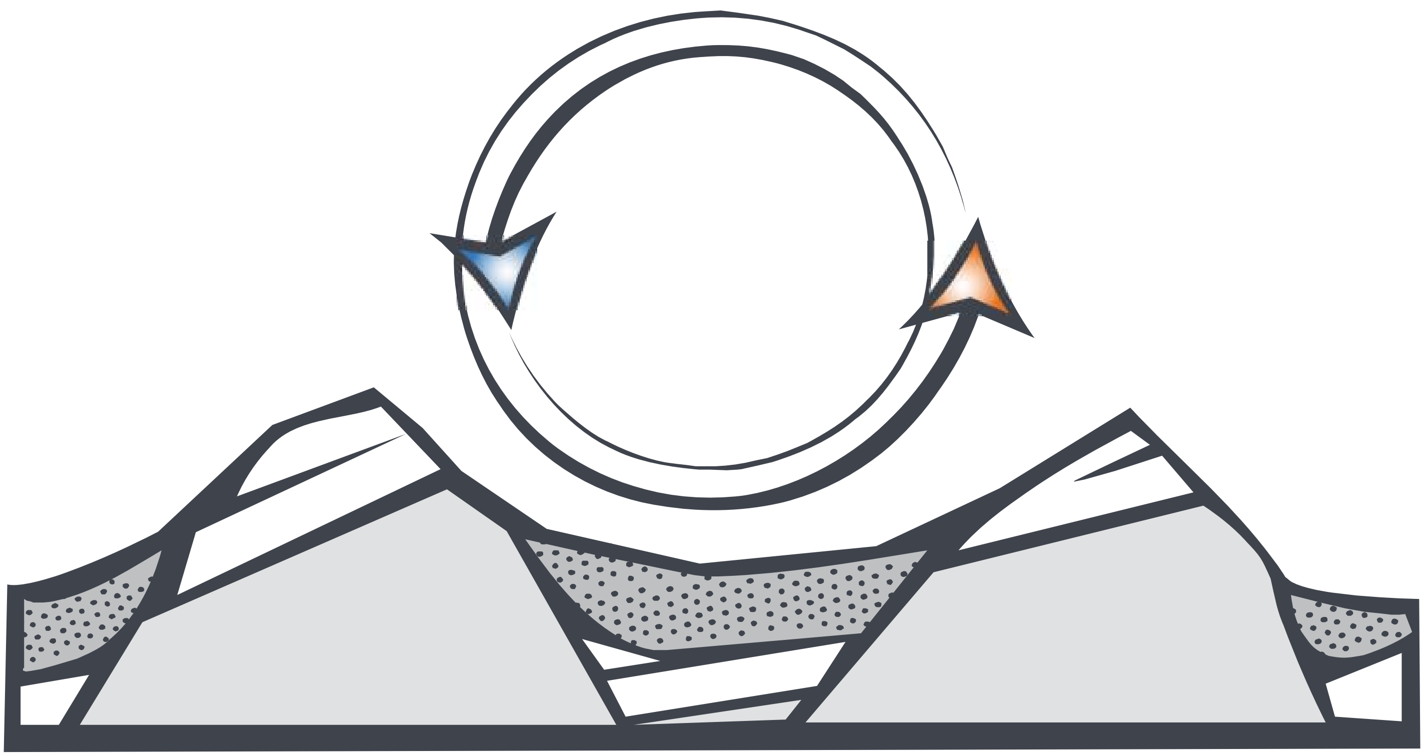
USFWS - United States Department of Interior, Fish and Wildlife Service

VRM - Visual Resource Management

WGA - Western Governors Association

WSR - Wild and Scenic River

WSA - Wilderness Study Area



EXECUTIVE SUMMARY

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EXECUTIVE SUMMARY

ES.1 INTRODUCTION

Recent government policies and advances in technology have increased the demand for accessing geothermal resources on federal lands in the western United States (US). About 530 million acres in the 12 western states of Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming have geothermal potential for electrical generation or direct heat applications (such as heating buildings, spas, and greenhouses). Of this area, approximately 143 million acres are lands administered by the US Department of the Interior (DOI), Bureau of Land Management (BLM) and 104 million acres are within the National Forest System (NFS) administered by the US Department of Agriculture (USDA) Forest Service (FS). This represents about 47 percent of all western lands that have geothermal potential. Tribal lands and federal lands within units of the National Wildlife Refuge System and National Park System are closed to geothermal leasing, and adjacent public and NFS lands require special analysis prior to issuance of geothermal leases.

The BLM has the delegated authority to issue geothermal leases on federal mineral estate, such as that underlying lands administered by the FS. A geothermal lease is for the earth's heat resource where there is federal mineral estate. The BLM currently (at the end of fiscal year 2007) administers approximately 480 geothermal leases that covered over 700,000 acres. Of those, 57 are producing geothermal energy, 54 are for electrical generation and three for direct use (BLM 2008b). Leasing geothermal resources by the BLM vests with the lessee a non-exclusive right to future exploration and an exclusive right to produce and use the geothermal resources within the lease area subject to existing laws, regulations, formal orders, and the terms, conditions, and stipulations in or attached to the lease form or included as conditions of approval in permits. Lease issuance alone does not authorize any ground-disturbing activities to explore for or develop geothermal resources without site specific approval for the intended operation. Such approval could include additional environmental reviews and permits.

ES.2 PROPOSED ACTION

The Energy Policy Act (EPAct) of 2005 (Public Law 109-58, August 8, 2005) recognizes the increasing demand for geothermal resources and the need to facilitate leasing decisions. In accordance with the EPAct, the BLM and the FS are proposing to make geothermal leasing decisions on pending lease applications submitted prior to January 1, 2005 and to facilitate geothermal leasing decisions on other existing and future lease applications and nominations.

To achieve this, the BLM and FS are proposing to do the following:

1. Identify public and NFS lands with geothermal potential as being legally open or closed to leasing.
2. Issue or deny geothermal lease applications pending as of January 1, 2005.

Under the proposal, the BLM would also do the following:

3. Identify public lands that are administratively closed or open to leasing, and under what conditions.
4. Develop a comprehensive list of stipulations, best management practices, and procedures to serve as consistent guidance for future geothermal leasing and development on public and NFS lands.
5. Amend BLM land use plans to adopt the resource allocations, stipulations, best management practices, and procedures.

All lands that are currently closed by statute to geothermal leasing would remain closed and would not be affected by the proposal. Examples of these lands include but are not limited to National Park System lands, wilderness areas, wilderness study areas, National Recreation Areas, Indian trust or restricted lands, and the Island Park Geothermal Area in Wyoming and Montana.

ES.3 PURPOSE OF AND NEED FOR ACTION

The purpose of the proposed action is threefold:

1. To complete processing active pending geothermal lease applications and nominations by deciding whether, and under what stipulations, to issue geothermal leases on NFS and BLM administered lands.
2. To amend BLM land use plans to allocate BLM-administered lands with geothermal resource potential as closed, open, or open with major or moderate constraints to geothermal leasing. This includes establishing a projected new level of potential geothermal development with existing planning level decisions, termed reasonably foreseeable development (RFD) scenario, and identifying appropriate stipulations, best management practices, and

procedures to protect other resource values and uses while providing sufficient pre-leasing analysis to enable the BLM to make future competitive geothermal leasing availability decisions.

3. To provide suitability information to the FS to facilitate its subsequent consent decision to the BLM for leasing on NFS lands. Provide environmental analysis to assist future NFS land use decisions by providing possible land use allocations and stipulations for geothermal leasing.

There are three needs for the federal action:

1. To issue decisions on pending lease applications in accordance with the EPAct of 2005. Specifically, Section 225 requires that the Secretary of Interior and Secretary of Agriculture establish a program for reducing by 90 percent the backlog of geothermal lease applications that were pending as of January 1, 2005. The EPAct of 2005 mandates that action be taken by August 8, 2010.
2. To address other provisions of the EPAct of 2005 (Sections 211 and 222[d][1]); respond to other policy directives calling for clean and renewable energy (see Section 1.8 Renewable Energy Policies); and to meet the increasing energy demands of the nation while reducing reliance on foreign energy imports, reducing greenhouse gas emissions, and improving national security.
3. To facilitate geothermal resource leasing in an environmentally responsible manner to help meet the increasing interest in geothermal energy development on public and NFS lands in the western US (EPAct Section 211).

ES.4 PLANNING AREA AND DOCUMENT SCOPE

This programmatic environmental impact statement (PEIS) analyzes the potential environmental, social, and economic effects of these actions in accordance with the National Environmental Policy Act of 1969 (NEPA), the Council on Environmental Quality's (CEQ) regulations for implementing NEPA (40 Code of Federal Regulations [CFR] 1500–1508), and applicable BLM and FS authorities.

The project area is defined as the 12 western states, including Alaska. The planning area is defined as the 530 million acres within the 12 western states that have the potential for geothermal resources. The planning area includes BLM- and FS-administered surface lands with minerals under federal ownership that have geothermal potential and the subsurface federal geothermal mineral estate on other lands. Surface lands administered by other federal agencies, such as the National Park Service and US DOI, Fish and Wildlife Service (USFWS), and state agencies are not assessed in this document unless their administrative boundaries overlap with public or NFS lands. If these lands have subsurface federal geothermal mineral estate, the BLM would apply the management direction provided in this PEIS, with the surface management agency's consent, for lease nominations or applications. Lands that are not administered by the BLM or FS, or that are closed to geothermal leasing by statute are not part of the analysis, including National Park System lands.

ES.5 ALTERNATIVES

Three alternatives are evaluated in detail in the PEIS: the no action alternative and two action alternatives. A comparison of the different allocations between the action alternatives is presented in Table ES-1.

Table ES-1
Comparison of Geothermal Resource Allocations between the Action Alternatives

	Alternative B: Proposed Action (acres)	Alternative C: Leasing Near Transmission Lines (acres)
Public Lands in Planning Area	143,154,205	143,154,205
NFS Lands in Planning Area	103,582,163	103,582,163
Public Lands Open to Indirect Use[1]	118,007,636	61,202,746
Public Lands Open to Leasing for Direct Uses	118,007,636	118,007,636
NFS Lands Open to Leasing for Indirect Use[1]	79,217,147	37,870,654
NFS Lands Open to Leasing for Direct Uses	79,217,147	79,217,147
Public Lands Closed to Indirect Use[1]	25,146,569	81,951,459
Public Lands Closed to Leasing for Direct Uses	25,146,569	25,146,569
NFS Lands Closed to Leasing for Indirect Use[1]	24,365,016	65,711,509
NFS Lands Closed to Leasing for Direct Uses	24,365,016	24,365,016

[1] Indirect use includes commercial electrical generation.

Alternative A: No Action

Alternative A is the No Action Alternative. Under this alternative, no BLM land use plans would be amended, and the existing plan decisions, stipulations, and allocations would not change as a direct result of the PEIS process. Therefore, any plans that do not address geothermal leasing would not be amended and the public and NFS lands would not be allocated as open or closed to geothermal leasing.

Processing of pending geothermal lease applications would continue; however, they would be evaluated on a case-by-case basis using analysis in the existing land use plans. Likewise, future lands nominated for leasing would be evaluated using analysis in existing land use plans. This could require additional NEPA documentation and possibly amendments to the plans. Many plans currently do not adequately address geothermal leasing, do not have allocation decisions for geothermal leasing, and do not have appropriate RFDs on geothermal leasing.

Taking no action would not facilitate the leasing process and does not meet the stated purpose and need; however, this alternative is analyzed in detail to provide a baseline from which to evaluate the other alternatives in accordance with CEQ guidance.

Alternative B: Proposed Action (Preferred Alternative)

Approximately 117 million acres of BLM administered public land would be allocated as open and 75 million acres of NSF land would be legally open to geothermal leasing for direct and indirect use subject to existing laws, regulations, formal orders, stipulations attached to the lease form, and the terms and conditions of the standard lease form. The authorized officer retains the discretion to issue leases with stipulations that impose moderate to major constraints on use of surface of any leases in order to mitigate the impacts to other land uses or resources objectives as defined in the guiding resource management plan. The 118 million acres of public land and 79 million acres of NFS land that would be open to geothermal leasing under the Proposed Action represent about 80 percent of public lands and NFS lands within the planning area. The remaining 25 million acres of BLM administered public land and 24 million acres of NFS lands in the planning area would be closed to geothermal leasing. The closed areas encompass non-discretionary and discretionary (BLM only) determinations, including the statutorily closed Island Park Geothermal Area. Island Park encompasses over 470,000 acres of NFS and public lands around the west and southwest boundary of Yellowstone National Park for the explicit purpose of protecting the geothermal features of the Park. The BLM would amend 122 land use plans to adopt the allocations, RFDs, and specific stipulations, best management practices, and procedures. Based on the analysis contained in the PEIS and public comments on the Draft PEIS, the BLM has selected Alternative B as the Preferred Alternative.

Alternative C: Leasing Lands near Transmission Lines

Under Alternative C, the BLM and FS would only consider leasing lands for commercial electrical generation if they are within a 20-mile corridor (10-mile from centerline) from existing transmission lines and lines currently under development at 60kV to 500kV. All lands within this corridor would be designated as closed or open with moderate to major constraints to leasing using the criteria outlined for the Proposed Action. Island Park Geothermal Area would also be closed (as with Alternative B); however, the area would be expanded to include no leasing within 15 miles of the boundary of Yellowstone National Park boundary. Given the limited transmission line grid and demand for localized power sources for remote communities, the lands available for geothermal leasing in Alaska would be the same as for Alternative B - Proposed Action. Leases for direct use would be considered for the entire planning area and would not be constrained by the location of transmission lines. Therefore, direct use leasing would be the same as the Proposed Action.

Under Alternative C, approximately 61 million acres of public land and 38 million acres of NFS lands would be open for geothermal leasing for commercial electrical generation. These lands would be subject to moderate to major constraints as detailed in the Proposed Action. This alternative would increase the amount of land that would be unavailable for geothermal leasing with in the planning area; specifically, about 81 million acres of public land and 66 million acres of NFS lands would be closed. Other lands outside the corridor would not be closed to leasing, but would require evaluation on a case-by-case basis as described under the No Action Alternative.

ES.6 REASONABLY FORESEEABLE DEVELOPMENT SCENARIO

An RFD for commercial electrical generation and direct use was developed to serve as a basis for analyzing environmental impacts resulting from future leasing and development of federal geothermal resources within the western US over the next 20 years. It is estimated that within the planning area there are 5,540 megawatts (MW) of geothermal potential considered viable for commercial electrical generation by 2015, with a further 6,660 to 6,670 MW being forecast by 2025. This capacity is expected to be realized through approximately 110 additional power plants by 2015, and a further 132 more power plants by 2025. Using these values, it is estimated that the average viable capacity at any particular site is 50 MW by 2025. Most of the development would likely occur in northern Nevada, California, and Idaho, with the least amount in Wyoming and Montana.

It is estimated that by 2015, direct use applications could be developed in the amount of 1,600 thermal MW, and by 2025, this number is estimated to be 4,200 thermal MW. This development could occur anywhere within the planning area.

ES.7 Impact Analysis

Designating lands for geothermal leasing potential and amending land use plans, in and of itself, does not cause any direct impacts as defined by CEQ regulations, which states that such effects "are caused by the action and occur at the same time and place" (40 CFR 1508.8[a]). It is reasonable, however, to foresee that on-the-ground impacts would occur if the BLM issues geothermal leases but that the impacts would not occur until some point in the future. Therefore, the analysis in the PEIS addresses both direct and indirect impacts based on the foreseeable on-the-ground actions, including exploration, drilling, and utilization. These impacts cannot be analyzed site-specifically, but they are analyzed for the planning area based on the RFD scenario. Additional site-specific analysis would be conducted during the permitting review process for subsequent exploration, drilling, and utilization applications.

A typical geothermal electrical generation plant has a surface disturbance of between 53 to 367 acres for all associated activities, such as exploration, drilling, and construction, depending on site conditions and the type of geothermal plant. Reclamation is done on areas that are no longer needed for these activities, so the actual area of disturbance for an operating power plant is generally much less. Geothermal resources also provide a wide range of direct use applications, which can require land disturbances of less than one acre to more than 50 acres. Geothermal development has similar short-term impacts as other land disturbing activities but has fewer long-term impacts compared to other energy generation activities. If geothermal leases were developed, the following general adverse impacts would be expected:

- Long-term loss of vegetation, habitat, and soil.
- Short-term and intermittent noise impacts from construction and maintenance activities. Operations would have minimal noise impacts in most areas on federal lands; however, areas with minimal noise sources (i.e., remote areas) would experience a greater change in the noise characteristics.
- Loss of some recreational opportunities from energy infrastructure, although new roads could provide access for additional recreational opportunities.
- Long-term visual impact from power plants and infrastructure.
- Short-term impact to ground water during drilling.
- Loss of other land uses, such as livestock grazing, on lands occupied by geothermal facilities.
- Short-term increase in air emissions from drilling and construction activities. Compared to nonrenewable energy sources, electrical

generation with geothermal resources has minimal emissions. Therefore, on a megawatt basis, geothermal production would have a beneficial long-term impact in reducing emissions and greenhouse gases.

The cumulative impacts associated with geothermal development, such as erosion, habitat loss and fragmentation, propagation of invasive species, and viewshed degradation, would occur but would be relatively minor. At the maximum projected build out in 2025, up to 89,500 acres could be disturbed from exploration, drilling, and utilization and operational activities. This represents less than 0.01 percent of the 17 million areas of public land that have other commercial uses. Geothermal developments also tend to have relatively small operational footprints compared to other uses (such as wind farms and oil and gas fields) and are generally compatible with other uses, such as livestock grazing.

The subsequent impacts from geothermal leasing are relational to the areas that are available for leasing. Alternative C would limit the areas open to geothermal leasing to 99 million acres while Alternative B proposes about 197 million acres as open to leasing. The No Action Alternative does not formally identify geothermal resources as open or closed for leasing; instead it relies on existing plans for determining any allocations on a case-by-case basis, if such allocations have been decided in the plan. If such determinations are not made, additional NEPA and a possible land use plan amendment would be required. Therefore, Alternative C would result in less future development and ground-disturbing activities compared to Alternative B. However, Alternative C would forego opportunities to use geothermal resources as a renewable energy source and to offset some of the impacts from conventional energy sources.

Under both Alternatives B and C, a comprehensive list of stipulations, best management practices, and procedures would be adopted through the land use amendment process and subsequent permitting to avoid, minimize and mitigate impacts associated with geothermal leasing, exploration, drilling, utilization, and reclamation and abandonment.

Chapter I

Purpose of and Need for Action

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CHAPTER 1
PURPOSE OF AND NEED FOR ACTION

1.1 INTRODUCTION

The goal of this project is to make geothermal leasing decisions on pending lease applications submitted prior to January 1, 2005 and to facilitate geothermal leasing decisions on other existing and future lease applications and nominations. Geothermal resources are abundant in the western United States (US) and have high potential for providing reliable base demand electrical generation and "direct use" heating applications. Recent Federal and state policies and advances in engineering and technology have increased the demand for accessing geothermal resources. Federal lands in the continental US contain about 46 percent of the nation's geothermal resources, and about 70 percent of Federal lands have potential for geothermal development, defined as heat flow above 140° Fahrenheit (F) (60° Celsius [C]) (Energy Information Administration 2007). Obtaining leases and development permits on Federal lands has been identified as a significant barrier for geothermal developers (Farhar 2000; Western Governors' Association 2006; Geothermal Energy Association 2007a). A notable constraint to leasing on Federal lands is that many land use plans and their associated environmental analyses do not adequately address geothermal resources, thereby requiring a land use plan amendment before geothermal resources can be leased. This constraint has resulted in a number of backlogged lease applications that require processing.

Public Lands: Lands administered by the BLM.

National Forest System Lands: Lands administered by the FS.

National Park System Lands: Lands administered by the National Park Service are closed to geothermal leasing.

In accordance with the Energy Policy Act (EPAct) of 2005 (Public Law 109-58, August 8, 2005), the US Department of the Interior (DOI), Bureau of Land Management (BLM) and the US Department of Agriculture (USDA), Forest Service (FS) propose to facilitate geothermal leasing on lands administered by the BLM (termed "public lands") and the FS (National Forest System [NFS] lands) that have geothermal potential in the 12 western states, including Alaska. Tribal lands and Federal lands within units of the National Wildlife Refuge System and National Park System are closed to geothermal leasing. Public and NFS lands in proximity to a National Park System unit with a "significant thermal feature" require special analysis prior to issuance of geothermal leases.

Under the proposal, the BLM and FS would do the following:

(1) Identify public and NFS lands with geothermal potential as being legally open or closed to leasing.

(2) Issue or deny geothermal lease applications pending as of January 1, 2005.

Under the proposal, the BLM would also do the following:

(3) Identify public lands that are administratively closed or open, and under what conditions.

(4) Develop a comprehensive list of stipulations, best management practices, and procedures to serve as consistent guidance for future geothermal leasing and development on public and NFS lands.

(5) Amend BLM land use plans to adopt the resource allocations, stipulations, best management practices, and procedures.

Approving the leasing and development of geothermal resources on public and NFS lands is a Federal action and requires analysis under the National Environmental Policy Act of 1969 (NEPA). This programmatic environmental impact statement (PEIS) evaluates the potential environmental, social, and economic effects of these actions in accordance with the NEPA, the Council on Environmental Quality's regulations for implementing NEPA (40 Code of Federal Regulations [CFR] 1500–1508), and applicable BLM and FS authorities. This PEIS presents broad impacts associated with the proposed action and alternatives to the proposed action. Programmatic evaluations are generally done for planning-level actions over large geographic areas (40 CFR 1502.4), which is appropriate for the proposed action. However, issuing decisions on the pending geothermal backlogged lease applications requires more lease-specific analysis, which is provided in Volume II of the PEIS.

This chapter describes the purpose of the proposed action and the need that is driving this process. This chapter also provides background on geothermal resources and how they are utilized, and a description of the process by which Federal geothermal resources are leased.

1.2 Purpose of the Action

The purpose of the proposed action is threefold:

1. To complete processing active pending geothermal lease applications and nominations by deciding whether, and under what stipulations, to issue geothermal leases on NFS and public lands.

2. To amend BLM land use plans to allocate BLM-administered lands with geothermal resource potential as closed, open, or open with major or moderate constraints to geothermal leasing. This includes establishing a projected new level of potential geothermal development with existing planning level decisions (termed

reasonably foreseeable development scenario), and identifying appropriate stipulations, best management practices, and procedures to protect other resource values and uses while providing sufficient pre-leasing analysis to enable the BLM to make future competitive geothermal leasing availability decisions.

3. To provide suitable information to the FS to facilitate its subsequent consent decision to the BLM for leasing on NFS lands. Provide environmental analysis to assist future National Forest land use decisions by providing possible land use allocations and stipulations for geothermal leasing.

1.3 NEED FOR THE ACTION

There are three needs for the Federal action:

1. To issue decisions on pending lease applications in accordance with the EPAct of 2005. Specifically, Section 225 requires that the Secretary of Interior and Secretary of Agriculture establish a program for reducing by 90 percent the backlog of geothermal lease applications that were pending as of January 1, 2005. The EPAct of 2005 mandates that action be taken by August 8, 2010.
2. To address other provisions of the EPAct of 2005 (Sections 211 and 222[d][1]); respond to other policy directives calling for clean and renewable energy (see Section 1.8 Renewable Energy Policies); and to meet the increasing energy demands of the nation while reducing reliance on foreign energy imports, reducing greenhouse gas emissions, and improving national security.
3. To facilitate geothermal resource leasing in an environmentally responsible manner to help meet the increasing interest in geothermal energy development on public and NFS lands in the western US (EPAct Section 211).

1.4 BACKGROUND FOR GEOTHERMAL RESOURCES

The term *geothermal* comes from the Greek *geo* meaning "earth" and *thermal* meaning "heat." As such, geothermal energy is energy derived from the natural heat of the earth. Geothermal resources are typically underground reservoirs of hot water or steam created by heat from the earth, but geothermal resources also include subsurface areas of dry hot rock. In cases where the reservoir is dry hot rock, the energy is captured through the injection of cool water from the surface, which is then heated by the hot rock and extracted as fluid or steam. Geothermal steam and hot water can naturally reach the earth's surface in the form of hot springs, geysers, mud pots, or steam vents. Geothermal reservoirs of hot water are also found at various depths beneath the Earth's surface. In the US, most geothermal reservoirs are located in the western states, Alaska, and Hawaii (NREL 2007). Geothermal resources can be accessed by wells and used to provide heat directly. This is called the *direct use* of geothermal energy. The heat energy can also be used to commercially generate electricity; a process called *indirect use*. As shown on Figure 1-1, there are a wide range of uses for geothermal resources.

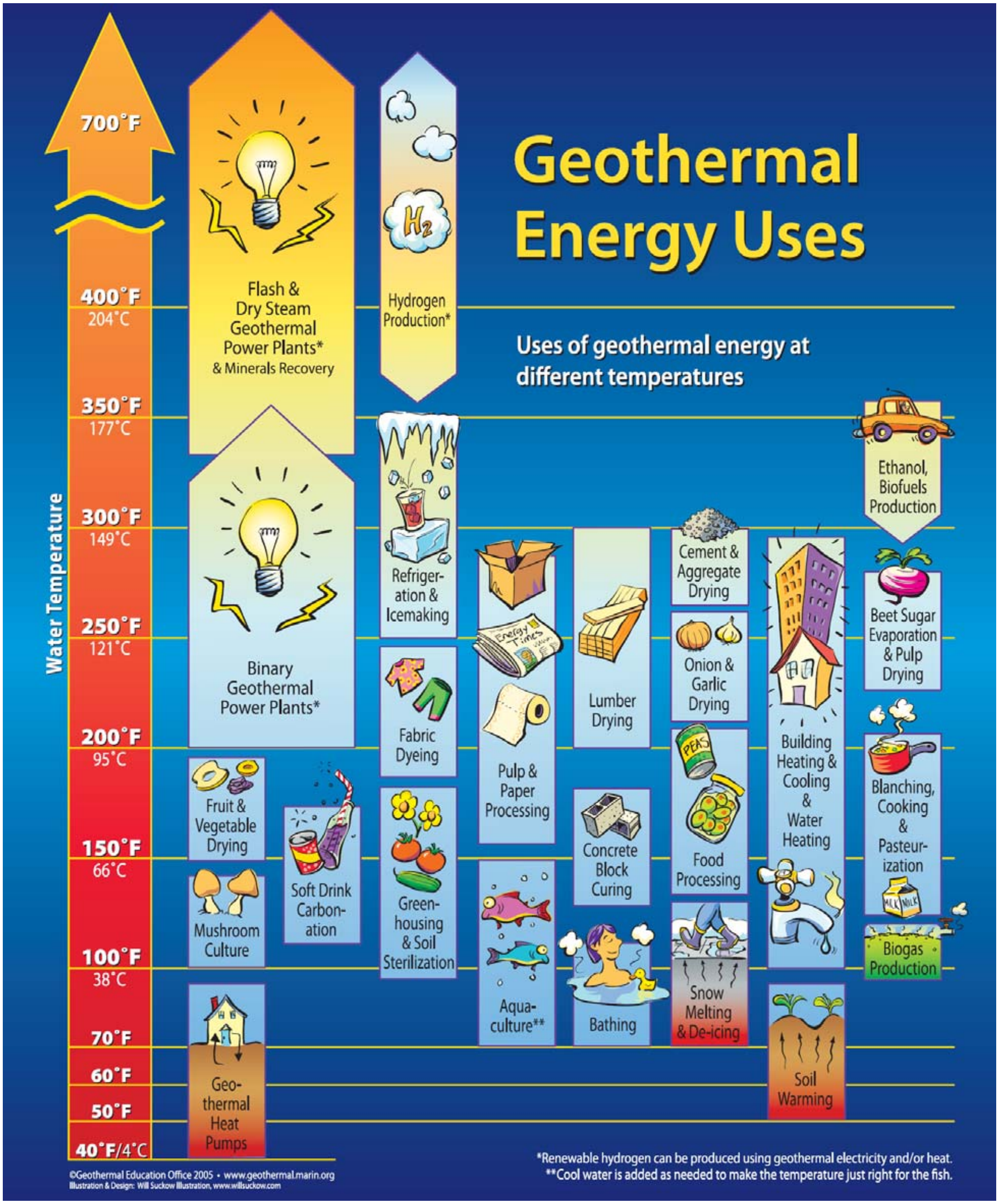
1.4.1 Direct Use

Humans have been using geothermal resources in the form of hot springs for thousands of years. Today, geothermal reservoirs of low- to moderate-temperature water – 68°F to 302°F (20°C to 150°C) – provide numerous opportunities for direct use. Direct use means utilization of geothermal resources for commercial, residential, agricultural, public facilities, or other energy needs other than the commercial production of electricity (43 CFR 3200.1). Direct use includes using heat energy from naturally occurring hot water or using other technology to capture the heat from the earth (e.g., heat pumps). Modern hot water direct-use systems access geothermal reservoirs by drilling into them from the surface to develop a steady stream of hot water. The water is brought up through the well, and a mechanical system consisting of piping, a heat exchanger, and controls delivers the heat directly for its intended use. A disposal system then either injects the cooled water underground or disposes of it on the surface.

Geothermal energy is used as heat in the US, either directly or through the use of ground-source heat pumps, for a variety of applications, such as:

- Heating pools, spas, greenhouses, aquaculture facilities, and buildings;
- Melting snow on sidewalks and driveways; and
- Drying agricultural products.

Direct use applications in the US have been growing at about six percent per year (Lund 2003). These low-temperature resources are fairly abundant throughout the West. A recent survey of 10 western states identified more than 9,000 thermal wells and springs, more than 900 low- to moderate-temperature geothermal resource areas, and hundreds of direct-use sites (Western Governors' Association 2006).



C://EMPSi/GeothermalPEIS/Figures

Geothermal energy has many uses, including heating, agriculture, and commercial electrical generation.

SOURCE: Geothermal Education Office 2005

Uses of Geothermal Energy

Figure 1-1

1.4.2 Commercial Electrical Generation

Commercial electrical generation from geothermal resources is also called *indirect use*. Electrical generation uses geothermally heated fluid to turn a turbine connected to a generator. As discussed below, the fluid may be the naturally occurring steam or water in the geothermal reservoir or another fluid which has the geothermal heat transferred through a heat exchange system.

What's a Watt?

A watt is the International System of Units standard unit of power and is the equivalent of one joule per second.

Kilowatt = 1,000 watts

Megawatt = 1,000 kilowatts

Gigawatt = 1,000 megawatts

Fast Facts:

- ✓ One megawatt serves about 1,000 homes in the US.
- ✓ The western US generates about 2,400 megawatts from geothermal resources annually.

Geothermal energy produces about 2,400 megawatts annually in the western US, supplying less than one percent of the US electrical demand (Energy Information Administration 2007). It is estimated that the 12 Western states have 5,500 MW of geothermal potential considered viable for commercial development by 2015, with a further 6,600 MW being forecast by 2025 (Section 2.6 discusses the reasonably foreseeable development scenario for electrical development).

Geothermal power plants can be small (300 kilowatts), medium (10 to 50 megawatts) and large (50 megawatts and higher) (Nemzer *et al.* 2007). Generation capacity is guided by the number of turbines within a plant. In general, commercial electrical generation requires hot geothermal reservoirs with a water temperature above 200°F (93°C); however, new technologies have proven that lower-temperature water (e.g., 165°F [74°C]) can also be used for electrical generation.

Three types of geothermal power plant systems are commonly used to generate electricity depending on temperature, depth, and quality of the water and steam in the area (US Department of Energy [DOE] 2007a):

(1) flash steam;

(2) binary-cycle; and

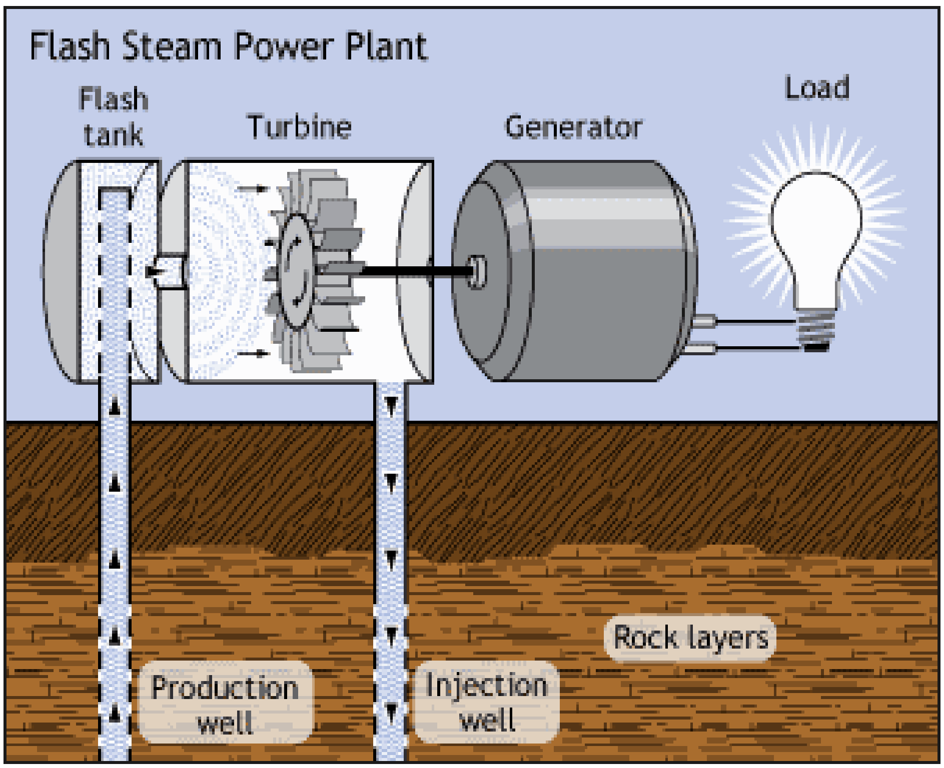
(3) dry steam power plants.

These plants can also be hybridized by including elements of the different technologies at a single location. All three methods reinject the remaining geothermal fluid back into the ground to replenish the reservoir and recycle the hot water.

Flash Steam Power Plants

Flash steam power plants use hot water above 360°F (182°C) from geothermal reservoirs. The high pressure underground keeps the water in the liquid state, although it is well above water's boiling point at standard atmospheric pressure. As the water is pumped from the reservoir to the power plant, the drop in pressure causes the water to convert, or "flash," into steam to power the turbine (Figure 1-2, Flash Steam Power Plant). Any water not converted into steam is injected back into the reservoir for reuse. Flash steam plants, like dry steam plants, emit small amounts of gases and steam. Flash steam plants are the most common type of geothermal power generation plants currently in operation (US DOE 2007a).

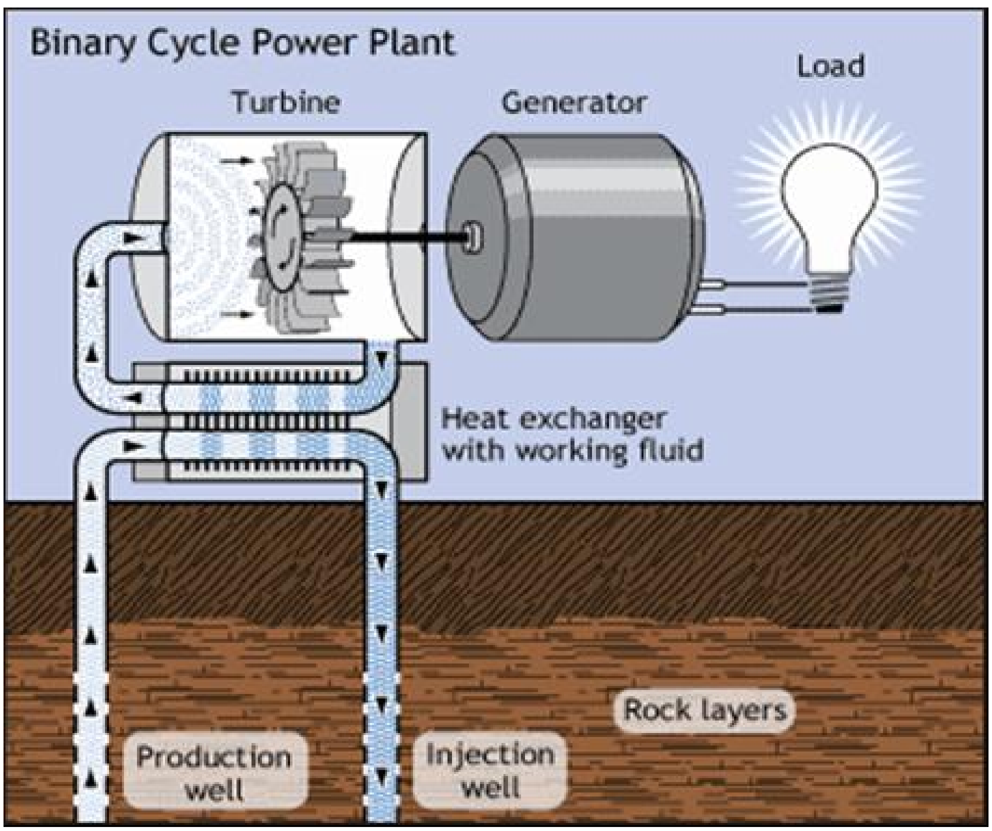
Figure 1-2
Flash Steam Power Plant



Binary Cycle Power Plants

Binary-cycle power plants typically use cooler fluids than flash steam plants (165 to 360°F [74 to 182°C]). The hot fluid from geothermal reservoirs is passed through a heat exchanger, which transfers heat to a separate pipe containing fluids with a much lower boiling point. These fluids, usually iso-butane or iso-pentane, are vaporized to power the turbine (Figure 1-3, Binary-cycle Power Plant). The advantage of binary-cycle power plants is their lower cost and increased efficiency. These plants also do not emit any excess gas and, because they use fluids with a lower boiling point than water, are able to use lower-temperature geothermal reservoirs, which are much more common. Most geothermal power plants planned for construction in the US are binary-cycle (US DOE 2007a).

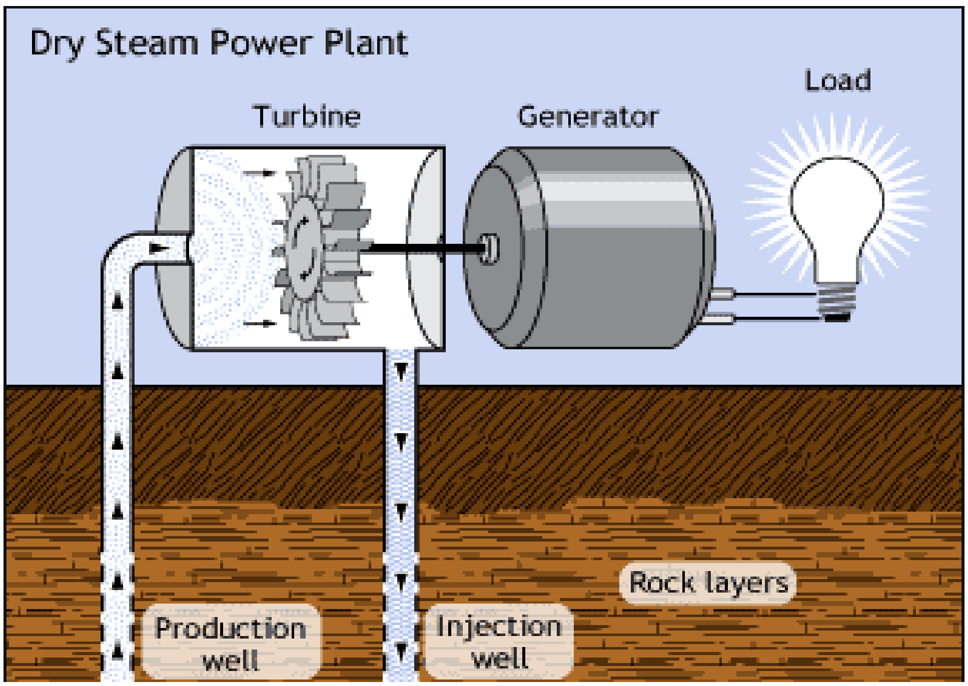
Figure 1-3
Binary Cycle Power Plant



Dry Steam Power Plants

Dry steam power plants use very hot (>455°F [235°C]) geothermal reservoirs that exist primarily in the form of steam. The steam is routed to the surface via a well and used to turn a turbine. The turbine drives a generator that produces electricity (Figure 1-4, Dry Steam Power Plant). While this is the rarest form of power plants, it was both the first type of geothermal reservoir used to produce electricity (at Lardarello, Italy, in 1904) and is the reservoir type being used at the world's largest geothermal production site, The Geysers in Northern California. Dry steam power plants emit only excess steam and very minor amounts of gases (US DOE 2007a). Geothermal sources with dry steam generation capability are very rare.

Figure 1-4
Dry Steam Power Plant



Emerging Technologies

Geothermal Energy from Oil and Gas Production

Oil and gas wells are typically thousands of feet deep and often produce very hot fluid. Along with the oil and gas, wells produce water that must be separated from the oil and gas and usually reinjected deep below domestic aquifers. The Rocky Mountain Oilfield Testing Center, located in the Teapot Dome Oilfield near Casper, Wyoming, is demonstrating the use of warm reservoir fluids from oil and gas production to produce electricity that can be used to power the oil and gas pumps (Rocky Mountain Oilfield Testing Center 2007). This technique is referred to as co-produced geothermal fluids or produced water cut (NREL 2006). Because the electricity is used on site, there is no need to purchase additional electricity which eliminates the need for power lines to be run to oil and gas facilities. This technology could be applied at many oil and gas facilities throughout the West.

Enhanced Geothermal Systems

Enhanced geothermal systems are engineered reservoirs created to produce energy from geothermal resources deficient in water and/or permeability (US DOE 2007b; US DOE 2006). With enhanced geothermal systems, a developing reservoir is targeted within a volume of rock that is hot and tectonically stressed. Through a combination of hydraulic, thermal, and chemical processes, the reservoir can be stimulated, causing fractures to open, extend, and interconnect. This creates a fluid-conductive fracture network and an interconnected reservoir system. The process can extend the margins of existing geothermal systems or can create entirely new ones wherever optimal thermal and tectonic conditions exist (University of Utah Energy and Geoscience Institute) 2007). Enhanced geothermal systems technology is relatively new in the geothermal field and has been found to have great potential for providing electrical power; one study found the potential for 100 gigawatts of power (US DOE 2006). Until recently, lack of research and development funding, government policies, and lack of incentives had not favored the growth of enhanced geothermal systems, with most development occurring outside of the United States (US DOE 2006). It is anticipated that there may be applications for research and development drilling on public and NFS lands in the future. Until it becomes a technically and economically proven technology, it is unlikely that it will be applied at a large scale in the western US within the next 20 years.

1.5 Leasing and Development Process of Geothermal Resources on Federal Lands

1.5.1 Geothermal Leasing Laws and Regulations

A geothermal lease is for the heat resource of the earth where there is Federal mineral estate. Unless specifically owned in fee, the Federal government does not own the hot water commonly associated with the heat; this falls under state water laws. Geothermal developers must obtain the appropriate water rights and state permits, in addition to the Federal lease for the resource.

The BLM has the delegated authority to issue geothermal leases on Federal lands. The BLM currently administers about 480 geothermal leases that covered over 700,000 acres at the end of fiscal year 2007. Of those 57 are producing geothermal energy, 54 producing resource for electrical generation and 3 for direct use (BLM 2008b). It is the policy of the Federal government, consistent with Section 2 of the Mining and Mineral Policy Act of 1970 and Sections 102(a)(7), (8), and (12) of the Federal Land Policy and Management Act of 1976 (FLPMA) (43 US Code [USC] 1701 *et seq.*), to encourage the development of mineral resources, including geothermal resources, on Federal lands. The Geothermal Steam Act of 1970 (30 USC Section 1001, *et seq.*), which was amended and supplemented by the EPAct of 2005, provides statutory guidance for geothermal leasing by the BLM. New Federal geothermal development regulations (43 CFR Parts 3000, 3200, and 3280 – Geothermal Resource Leasing and Geothermal Resources Unit Agreements) were made effective June 1, 2007 (72 Fed Reg. 24358, May 2, 2007), as a result of a directive provided in the EPAct of 2005. These statutes and regulations delineate lands that are available and unavailable for leasing.

1.5.2 Available and Unavailable Lands for Geothermal Leasing

In accordance with the Geothermal Steam Act of 1970, as amended (30 USC Section 1001) and the Geothermal Resources Leasing Rule (43 CFR 3201.10), the BLM may issue leases on the following "available" lands:

- Lands administered by the DOI, including public and acquired lands not withdrawn from such use;
- Lands administered by the USDA with its concurrence;
- Lands conveyed by the US where the geothermal resources were reserved to the US; and
- Lands subject to Section 24 of the Federal Power Act, as amended (16 USC 818), with the concurrence of the Secretary of Energy.

Conversely, the BLM is prohibited from issuing leases on the following statutorily closed Federal lands as defined in the Geothermal Resources Leasing Rule (43 CFR 3201.11). Other lands administered directly by the BLM and FS may also be closed through other authorities, which are discussed in Chapter 2.

- Lands where the Secretary of Interior (Secretary) has determined that issuing the lease would cause unnecessary or undue degradation of public lands and resources;
- Lands contained within a unit of the National Park System, or that are otherwise administered by the National Park Service;
- Lands where the Secretary determines after notice and comment that geothermal operations, including exploration, development, or utilization of lands, are reasonably likely to result in a significant adverse effect on a significant thermal feature within a unit of the National Park System;
- Lands within a National Recreation Area;
- Fish hatcheries or wildlife management areas administered by the Secretary;
- Indian trust or restricted lands within or outside the boundaries of Indian reservations;

- The Island Park Geothermal Area (in Idaho and Montana); and
- Lands where Section 43 of the Mineral Leasing Act (30 USC 226-3) prohibits geothermal leasing, including:
  - Wilderness areas or Wilderness Study Areas administered by the BLM or other surface-management agencies;
  - Lands designated by Congress as Wilderness Study Areas, except where the statute designating the study area specifically allows leasing to continue; and
  - Lands within areas allocated for wilderness or further planning in Executive Communication 1504, Ninety-sixth Congress (House Document 96-119), unless such lands are allocated to uses other than wilderness by a land and resource management plan or are released to uses other than wilderness by an act of Congress.

1.5.3 Leasing Process, Rights, and Limitations

The BLM grants access to geothermal resources through a formalized leasing process based on the end use. For direct uses, an applicant can apply noncompetitively for a lease. For indirect use, such as commercial electrical generation, the BLM awards leases through a competitive bidding process. Historically, certain lands were designated as known geothermal resource areas (KGRAs). All lands designated within KGRAs were leased through a competitive bidding process. Until the passage of the EPAct of 2005, lands outside of KGRAs could be leased noncompetitively. Section 222 of the EPAct of 2005 modified the Geothermal Steam Act of 1970 to allow only competitive lease sales for all Federal geothermal resources and their associated lands. The geothermal leasing regulations provide for four types of lands available for noncompetitive leasing: (1) Parcels of land that did not receive bids in a competitive sale; (2) Lands available exclusively for direct use; (3) Lands subject to mining claim and a current plan of operation; and (4) Lands for which a lease application was pending on August 8, 2005, if the applicant so chooses. Lease areas are nominated by the public for a lease sale.

When the BLM receives a nomination, it is adjudicated, and configured into lease parcels by the respective BLM state office. Lease parcels are then forwarded to the appropriate field office or FS regional office where the appropriate environmental analysis and review is conducted. This process is discussed in detail below.

The four stages of geothermal resource development within a lease are exploration, drilling operations, utilization, and reclamation and abandonment. Each stage requires a permit from the BLM. Leasing geothermal resources by the BLM vests with the lessee a non-exclusive right to future exploration and an exclusive right to produce and use the geothermal resources within the lease area, subject to existing laws, regulations, formal orders, and the terms, conditions and stipulations in or attached to the lease form or included as conditions of approval to permits. Lease issuance alone does not authorize any ground-disturbing activities to explore for or develop geothermal resources without site specific approval for the intended operation. Such approval could include additional environmental reviews and permits. Also at each stage, the BLM, in consultation with the FS on NFS lands, can issue site-specific conditions-of-approval to protect resource values. The specific activities associated with each phase are detailed in Chapter 2.

A lease is issued for a primary term of 10 years and may be extended for two five-year periods. Each of these extensions is available provided the lessee meets the work commitment requirements or lessee made payment in lieu of minimum work requirements of each year. At any time a lease may receive a 5-year drilling extension. Once commercial production is established, the lease may receive a production extension of up to 35 years and a renewal period of up to 55 years. The lease must continue to produce to remain in effect. BLM may grant a suspension of operations and production on a lease when justified by the operator (see 43 CFR 3207).

Geothermal exploration and production on Federal land conducted through leases is subject to terms and stipulations to comply with all applicable Federal and state laws pertaining to various considerations for tribal interests, sanitation, water quality, wildlife, safety, cultural resources, and reclamation.

1.5.4 Environmental Review Requirements for Lease Sales

All geothermal decisions must be provided for and in conformance with the applicable land use plan. Prior to geothermal lease sales, individual BLM field offices must prepare Documentation of Plan Conformance and NEPA Adequacy (also termed DNAs) for parcels within their respective jurisdictions to determine: (1) whether the issuance of a particular lease is in conformance with the applicable land use plan; and (2) whether the BLM can properly rely upon existing NEPA documents that analyze the potential impacts of geothermal leasing (i.e., an environmental impact statement that accompanies a land use plan). Additionally, the BLM must also document completion of required government to government consultation with tribes and environmental reviews required to comply with other laws, including but not limited to the Endangered Species Act and National Historic Preservation Act.

While a DNA can provide NEPA compliance, it is not an "environmental document" per se, and cannot supply missing analysis; if the DNA evaluation shows a need for further analysis, a new or supplemental NEPA document would need to be prepared. Upon completion of the DNA, the BLM field office can make one of the following recommendations to the BLM State Office: (1) the parcel(s) be offered for sale; (2) the parcel(s) be offered for sale with slightly modified legal descriptions or additional lease sale notices and stipulations.

Stipulations could include areas identified for no surface occupancy (NSO), areas subject to controlled surface use (CSU), or areas subject to timing limitations; (3) that certain parcels not be offered for lease until additional NEPA and/or planning documentation is prepared; or (4) deny the lease due to lack of conformance with the existing land use plan. This PEIS seeks to amend appropriate land use plans to facilitate the leasing process.

On NFS lands, where the BLM leases the mineral estate, the FS forwards consent determinations to BLM as to which parcels should be offered for lease. The BLM cannot lease lands over the objection of the FS. The FS makes its consent decision after conducting a leasing analysis, including NEPA. This analysis determines if an area is administratively open to leasing and if so, what if any special stipulations are required. The proposed action identifies the lands open to leasing and those that are closed by statute, regulation, or order. The FS will conduct a separate process to determine if these lands are administratively open or closed. This subsequent leasing determination will be used to amend FS land use plans, as appropriate.

All National Park System lands are closed to geothermal leasing. If a lease parcel is near a National Park, the BLM and FS, in coordination with the National Park Service, must also determine if any subsequent development would likely impact a "significant thermal feature" within a unit of the National Park System. National Parks with such significant thermal features include, but are not limited to, the following areas: Mount Rainier National Park, Crater Lake National Park, Yellowstone National Park, John D. Rockefeller, Jr. Memorial Parkway, Bering Land Bridge National Preserve, Gates of the Arctic National Park and Preserve, Katmai National Park, Aniakchak National Monument and Preserve, Wrangell-St. Elias National Park and Preserve, Lake Clark National Park and Preserve, Lassen Volcanic National Park, Lake Mead National Recreation Area, Hot Springs National Park*, Big Bend National Park (including that portion of the Rio Grande National Wild Scenic River within the boundaries of Big Bend National Park)*, Hawai'i Volcanoes National Park*, and Haleakala National Park* (10 USC Section 1026[a]).

If the Secretary of the Interior determines that exploration, development, or utilization of the lease parcel is "reasonably likely to result in a significant adverse effect on a significant thermal feature within a unit of the National Park System," then the lease would not be issued. If it is determined that use of the lease would be "reasonably likely to adversely affect" any significant thermal feature, then stipulations are included on leases and permits to protect the thermal features (10 USC Section 1026[c][d])."

1.6 AREAS WITH GEOTHERMAL POTENTIAL

In order to assess where geothermal development could occur, the BLM and FS, in partnership with the US DOE and US Geological Survey (USGS), conducted a detailed evaluation of the literature and state of the science to create a geothermal potential map of the planning area. The Notice of Intent (NOI) to prepare this PEIS (72 Fed Reg. 32679, June 13, 2007) noted that the PEIS would evaluate leasing on lands with moderate to high geothermal potential. Based on input from the public, industry, and other Federal, state, and local agencies, it was determined that the scope of the analysis needed to ensure that the geothermal potential area captures all opportunities for direct use, in addition to commercial electrical generation. It was also noted that the terms moderate and high potential were historically tied to use; however, as discussed earlier, there is a dynamic range of direct and indirect uses, and rapidly changing technology is lowering temperatures for electrical generation. Therefore, for the PEIS the geothermal potential area focuses on areas where there may be underground reservoirs of hot water or steam created by heat from the earth, or that have subsurface areas of dry hot rock. These areas are where the BLM and FS would likely receive geothermal lease nominations and applications in the near future.

1.6.1 Mapping Methods

Primary data sources for assessing geothermal potential included scientific literature; government, academic, and industry sources; and other stakeholders who identified areas of interest during the public scoping process. The BLM and FS initially reviewed geothermal potential maps from various sources and identified the assessments most commonly accepted by government agencies involved in geothermal research and development and the geothermal industry. Some of the states have conducted extensive research into geothermal potential; this information was collected and incorporated. The status of geothermal resources by state is provided in Appendix A (State of the States).

The most recent and widely accepted maps were produced in 2005 by the Idaho National Engineering and Environmental Laboratory. The laboratory produced geothermal resource maps of 13 western states for the US DOE. The maps were developed by: 1) digitizing the geothermal maps of each state that were published by the National Oceanographic and Atmospheric Administration (NOAA) and the USGS in the 1980 to 1983 timeframe, also known as the Circular 790 maps; and 2) incorporating data from other sources, some of which were state-specific. In 2007, at the request of the BLM and FS, the Idaho National Engineering and Environmental Laboratory merged the state-specific maps into a single resource potential map for the 12-state PEIS project area. The laboratory also reevaluated the maps and made adjustments as appropriate where new data had become available.

This new map was then overlain with the following data sources that were considered indicators of geothermal potential, and then the potential area was expanded as necessary to include any such missing areas.

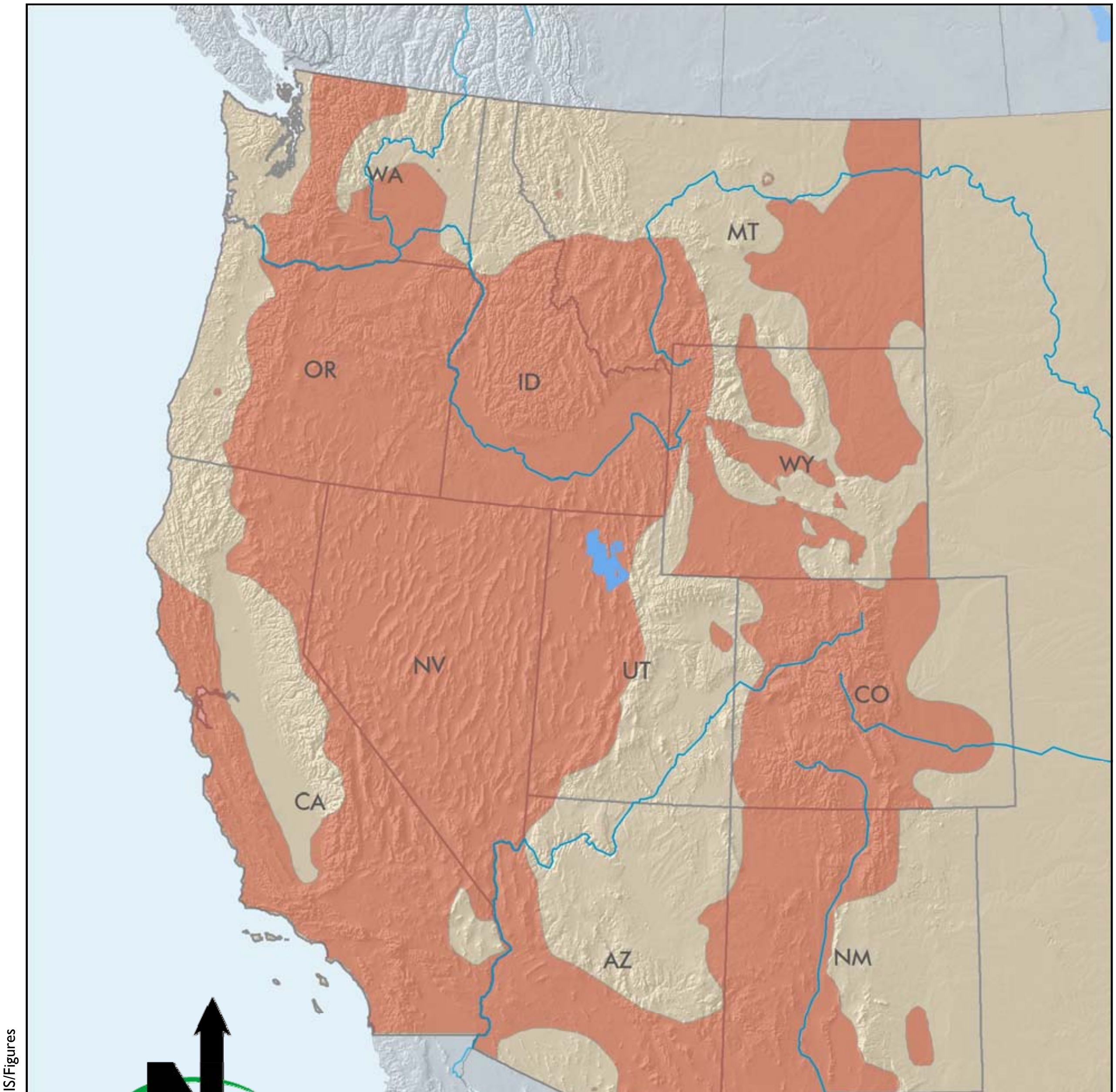
- Locations of operating geothermal facilities;
- Locations of issued leases and pending lease applications on BLM and FS lands;
- Maps provided by state agencies showing areas that they have identified as having geothermal potential, along with any other data on geology, water chemistry, and hydrogeology; and
- Areas identified during PEIS scoping comments from individuals, state agencies, and industry.

After inclusion of the above data sources, the BLM, FS, and US DOE identified further areas to be included that were known to have geothermal potential but had not appeared in any of the information sources listed above. The results were reviewed by subject experts within the BLM, FS, US DOE, USGS, and academia.

1.6.2 Western US Geothermal Potential Areas

In total, about 530 million acres in the 12 western states, including Alaska, are identified as having geothermal potential for indirect or direct applications (Figures 1-5, Areas of Geothermal Potential in the 11 Western States, and 1-6, Areas of Geothermal Potential in Alaska). The hottest resources and where commercial electrical generation would most likely occur, are generally within central and northern Nevada, western Utah, southern and central Idaho, southern and northeastern California, southeast Oregon, and along the Cascade mountain range. The reasonably foreseeable development scenario in Chapter 2 provides more specific details on the locations of where commercial electrical generation could likely occur.

Within the geothermal potential area, about 47 percent of the surface estate is administered by the BLM or FS. Approximately 143 million acres are on public lands within 103 BLM field offices and covered by over 130 BLM land use plans. There are approximately 104 million acres with geothermal potential on NFS lands within 68 National Forest units administered by 254 ranger districts. The acreage by BLM and FS administration by state is summarized in Table 1-1, BLM Public and NFS Lands Included in the Geothermal Potential Area. A detailed listing of the specific BLM Field Offices and National Forests, and their associated acres, is provided in Chapter 2.



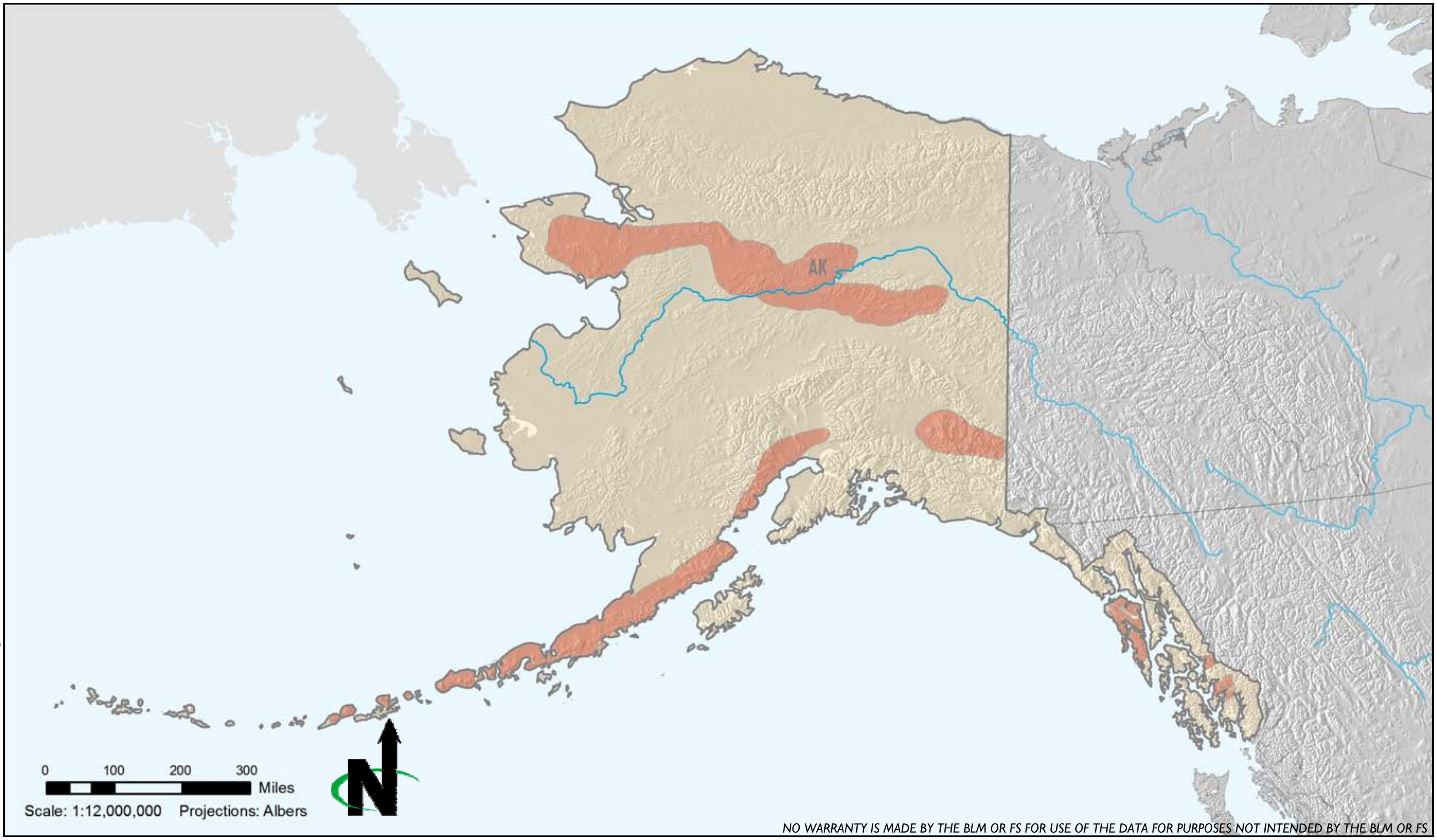
Over 480 million acres in the 11 western states have geothermal potential.

LEGEND:

Geothermal potential area

Areas of Geothermal Potential in the 11 Western States

Figure 1-5



About 50 million acres in Alaska have the potential for geothermal resources.

LEGEND:

Potential geothermal area

Areas of Geothermal Potential in Alaska

Figure 1-6

Table 1-1
BLM Public and NFS Lands Included in the Geothermal Potential Area

State	BLM Public Lands (Acres)	NFS Lands (Acres)[1]
Alaska	5,860,536	2,732,322
Arizona	8,842,090	2,166,912
California	13,969,825	13,467,992
Colorado	6,288,740	15,878,198
Idaho	12,716,814	17,767,599
Montana	3,438,730	8,370,307
Nevada	45,991,073	6,221,008
New Mexico	9,507,142	8,314,108
Oregon	14,025,425	14,746,444
Utah	10,766,598	3,056,933
Washington	--[3]	6,430,898
Wyoming	11,747,232	4,429,442
Total	143,154,205	103,582,163

Source: BLM 2008a
[1] Calculations are based on FS ranger district acreage. Acreage is assigned to the state in which the ranger district's address is located, as many ranger districts cross state lines.
[2] Does not include Native or state selected lands.
[3] Acreage calculations for Oregon and Washington are combined because states share one single BLM state-level office.

1.7 BUREAU OF LAND MANAGEMENT AND FOREST SERVICE LAND PLANNING PROCESS

The BLM administers approximately 258 million acres of public lands and 700 million acres of subsurface mineral estate in the US. This administrative responsibility must balance stewardship, conservation, and competing resource use, including the development of energy resources in an environmentally sound manner. Management of these public lands must be conducted in accordance with the requirements of the FLPMA and many other public laws. The FLPMA requires the BLM to develop land use plans, also called resource management plans (RMPs), to guide the management of the public lands it administers. An RMP typically covers public lands within a particular BLM field office. In order for geothermal leasing to occur on public lands, geothermal resource development must be allocated as an allowable use in the appropriate land use plan. If the plan does not include an allocation of some lands as open to geothermal leasing, or if the level of use (reasonably foreseeable development) for geothermal resources is absent or outdated, the land use plans for where such leasing would occur must be amended.

This PEIS is being developed to support the amendment of BLM land use plans covering those areas where leasing may eventually be proposed. An amendment is initiated when a proposal changes the scope of resource uses or a change in the terms, conditions and decisions of an approved plan (43 CFR 1610.5-5). The Record of Decision (ROD) for this PEIS could amend 123 BLM land use plans as discussed in Chapter 2. Amendments would include allocating BLM-administered lands with geothermal resource potential as closed, open, or open with major or moderate constraints to geothermal leasing. This includes establishing a projected new level of potential geothermal development with existing planning level decisions (termed reasonably foreseeable development scenario), and identifying appropriate stipulations, best management practices, and procedures to protect other resource values and uses while providing sufficient pre-leasing analysis to enable the BLM to make future competitive geothermal leasing availability decisions.

The FS administers about 192 million acres of lands in the US. The FS administrative responsibility must address stewardship of the National Forest System (NFS) to sustain the health, diversity, and productivity of the nation's forests and grasslands to meet the needs of present and future generations. Management of NFS lands must be conducted in accordance with the requirements of the National Forest Management Act of 1976 (16 USC 1600) and many other public laws. The FS administers its lands under land management plans, or forest plans, which are generally prepared for each National Forest. Forest plans provide the overall guidance (goals, objectives, standards, and management area direction) to achieve the desired future condition for the area being analyzed, and they contain specific management area prescriptions for each National Forest.

The FS uses the information in the Forest Plans in conducting leasing analysis for proposed geothermal leases. Under this analysis the FS determines if an area is administratively open for leasing and if it should be leased. If available for leasing, the analysis also evaluates if additional stipulations would be required to meet the goals and objectives of the Forest plan. This project will identify areas that are legally open to leasing; however, the FS will conduct a subsequent process to determine if these lands are administratively open. This subsequent leasing determination could be used to amend FS land use plans as appropriate. If the FS elects to amend a plan, the FS would follow its own procedures for any necessary NEPA compliance, which could include tiering to the PEIS. For pending lease applications on NFS lands included in this project (see Volume II), the FS would use this PEIS process to conduct leasing analyses and make final leasing consent decisions.

1.8 Renewable Energy Policies

1.8.1 Energy Policy Act of 2005

The EPAct of 2005 encourages the leasing and development of geothermal resources on Federal lands. Specifically, Section 225 requires that the Secretary of Interior and Secretary of Agriculture establish a program for reducing by 90 percent the backlog of geothermal lease applications that were pending as of January 1, 2005. The EPAct of 2005 mandates that action be taken by August 8, 2010. As of January 1, 2005, there were 194 applications for geothermal leases pending on BLM and FS lands (Clarke 2006).

Section 211 of the EPAct of 2005 provides a ten-year goal for the Secretary of the Interior to seek approval of non-hydropower renewable energy projects located on the public lands with a generation capacity of at least 10,000 megawatts of electricity, including electricity from geothermal resources. Section 223 gives the Secretary of the Interior authority to identify areas that could be leased exclusively for direct use of geothermal resources.

Section 222(d)(1) of the EPAct of 2005 states that, "It shall be a priority for the Secretary [and the FS] to ensure timely completion of administrative actions, including amendments to applicable forest plans and RMPs, necessary to process applications for geothermal leasing pending on the date of enactment of this subsection." This section also contains the requirement that, "All future forest plans and RMPs for areas with high geothermal resource potential shall consider geothermal leasing and development."

Section 225 requires a memorandum of understanding between the BLM and the FS (completed April 14, 2006) that will, among other tasks:

- Establish a five-year program for geothermal leasing for National Forest System lands and a process for updating that program every five years; and
- Establish a program for reducing the backlog of geothermal lease applications pending as of January 1, 2005, by 90 percent (by August 8, 2010).

The memorandum of understanding was completed on April 14, 2006 and is provided in Appendix B (*Memorandum of Understanding: Implementation of Section 225 of the Energy Policy Act of 2005 Regarding Geothermal Leasing and Permitting*).

1.8.2 Executive Order 13212

On May 18, 2001, the President signed Executive Order 13212, Actions to Expedite Energy-Related Projects, which states that, "the increased production and transmission of energy in a safe and environmentally sound manner is essential." Executive departments and agencies are directed to "take appropriate actions, to the extent consistent with applicable law, to expedite projects that will increase the production, transmission, or conservation of energy." Executive Order 13212 further states that: "For energy-related projects, agencies shall expedite their review of permits or take other actions as necessary to accelerate the completion of such projects, while maintaining safety, public health, and environmental protections. The agencies shall take such actions to the extent permitted by law and regulation and where appropriate." This PEIS addresses the leasing of geothermal resource for energy production. The BLM completed a PEIS for wind energy development on western lands in 2005, and an interagency team is preparing a PEIS for establishing corridors for energy transmission (including electrical lines and pipelines) (BLM 2005a; US DOE and BLM 2007).

1.8.3 Climate Change Policy

In 2002, the Federal government released the Global Climate Change Initiative and Policy Book that outlines a comprehensive plan to address climate change. The plan includes a goal to reduce the greenhouse gas intensity of the US economy by 18 percent over the ten-year period from 2002 to 2012 and to provide initiatives to reduce greenhouse gas emissions, including encouraging renewable energy resources development (US White House 2002). A study comparing greenhouse gas emissions from electrical generation using fossil fuels and geothermal fluids found that geothermal produces an order of magnitude less in carbon dioxide, hydrogen sulfide, methane, and ammonia. Table 1-2, Comparison of Geothermal and Fossil Fuel Carbon Dioxide Emissions for Electrical Generation, highlights the difference in emissions of carbon dioxide from these different energy sources. Direct use of geothermal resources, such as using geothermal to heat buildings, has the potential to displace 18 million barrels of oil per year (Western Governors' Association 2006). Increased geothermal energy utilization could help the US reduce greenhouse gas emissions and meet policy goals (Bloomfield *et al.* 2003).

Table 1-2
Comparison of Geothermal and Fossil Fuel Carbon Dioxide Emissions for Electrical Generation

	Geothermal	Coal	Petroleum	Natural Gas
Emissions (pounds carbon dioxide per kilowatt-hour)	0.20	2.095	1.969	1.321

Source: Bloomfield *et al.* 2003

On the state level, many states have passed renewable portfolio standards, which require electric utility providers to obtain a minimum percentage of their energy from renewable generation sources (including geothermal, wind, solar, hydroelectric, and other renewables such as biomass and tidal). Geothermal development has the potential to make significant contributions to meeting renewable portfolio standards, especially given that it provides reliable and consistent base power, unlike solar or wind. A summary of states that have legislative renewable portfolio standards is provided in Table 1-3, State Renewable Portfolio Standards (as of April 2008).

In 2005, the Western Governors' Association established the Clean and Diversified Energy Initiative, which included forming the Geothermal Task Force. The Task Force issued a detailed report on geothermal potential and constraints and a strategy for improving geothermal development. A key recommendation of the report was a call for initiatives to facilitate the timely leasing and permitting of geothermal resources (Western Governors' Association 2006).

What is a renewable portfolio standard?

The renewable portfolio standard is a legal requirement that obligates each retail seller of electricity to include in its resource portfolio (the resources procured by the retail seller to supply its retail customers) a certain amount of electricity from renewable energy resources, such as wind, solar and geothermal energy. The retailer can satisfy this obligation by either:

(1) Owning a renewable energy facility and producing its own power; or

(2) Purchasing renewable electricity from someone else's facility.

Renewable portfolio standard policies are implemented at the state level and vary considerably in their requirements with respect to their time frame, resource eligibility, treatment of existing plants, arrangements for enforcement and penalties, and whether they allow trading of renewable energy credits.

Using a renewable portfolio standard has recently become one of the most popular ways to encourage greater use of renewable energy. A renewable portfolio standard is an efficient method of meeting policy targets for greater use of renewable energy, and can be implemented in both regulated and restructured markets.

Source: US Department of Energy 2007

Table 1-3
Western States Renewable Portfolio Standards (as of April 2008)

State	Amount[1]	Year[2]	Organization Administering Renewable Portfolio Standards
Arizona	15%	2025	Arizona Corporation Commission
California	20%	2010	California Energy Commission
Colorado	20%	2020	Colorado Public Utilities Commission
Montana	15%	2015	Montana Public Service Commission
New Mexico	20%	2020	New Mexico Public Regulation Commission
Nevada	20%	2015	Public Utilities Commission of Nevada
Oregon	25%	2025	Oregon Energy Office
Washington	15%	2020	Washington Secretary of State

[1] Percentages refer to a portion of electricity sales and megawatts to absolute capacity requirements.
[2] Most of these standards phase in over years, and the date refers to when the full requirement takes effect.
Source: US DOE 2007c

1.9 Scope of Analysis

As previously stated, Section 225 of the EPAct of 2005 requires that the US DOI and USDA Forest Service reduce the backlog of geothermal lease applications pending as of January 1, 2005, by 90 percent (by August 8, 2010). Section 222(d) dictates that it be a priority for the BLM and the FS to ensure timely completion of actions such as amendments to FS plans and RMPs necessary to process lease applications pending on August 8, 2005, and that all future forest plans and RMPs in areas of geothermal resource potential consider geothermal leasing and development. To respond to these directives and the stated need for action, the PEIS incorporates two different scopes for analysis. The first scope covers the programmatic analysis to allocate lands as available for leasing and development of geothermal resources and apply stipulations. The second scope covers the site-specific analysis of the backlogged lease application areas.

1.9.1 Programmatic Scope

Project Area: The 12 western states, including Alaska.

Planning Area: Lands with geo-thermal potential in the 12 western states.

For the programmatic analysis, the "project area" is defined as the western US (Alaska, Arizona, California, Colorado, Idaho, Nevada, New Mexico, Montana, Oregon, Utah, Washington, and Wyoming). The "planning area" for which planning level decisions would be made, is the defined area of geothermal potential (see Section 1.6.2 Western US Potential Areas). The planning area includes BLM- and FS-administered surface lands with minerals under Federal ownership that have geothermal potential and the subsurface Federal geothermal mineral estate on other lands. Surface lands administered by other Federal agencies, such as the National Park Service and US DOI, Fish and Wildlife Service (USFWS), and state agencies are not assessed in this document unless their administrative boundaries overlap with public or NFS lands. If these lands have subsurface Federal geothermal mineral estate, the BLM would apply the management direction provided in this PEIS, with the surface management agency's consent, for lease nominations or applications.

Lands that are not administered by the BLM or FS, or that are closed to geothermal leasing by statue, are not part of the analysis. These include lands contained within a unit of the National Park System, or that are otherwise administered by the National Park Service; fish hatcheries or wildlife management areas administered by the Secretary; State fish and wildlife refuges and state parks; and Indian trust or restricted lands within or outside the boundaries of Indian reservations (43 CFR 3201.11).

This PEIS is a programmatic document that analyzes the broad impacts associated with allocation of geothermal resources for leasing along with the adoption of stipulations and best management practices. As such, it meets the intent of the implementing regulations for the NEPA, which state, "Agencies shall prepare statements on broad actions so that they are relevant to policy and are timed to coincide with meaningful points in the agency planning and decisionmaking" (40 CFR 1502.4). The PEIS does not evaluate site-specific issues associated with geothermal exploration, drilling, utilization, or reclamation and abandonment. A variety of location-specific factors (e.g., soil type, watershed, habitat, vegetation, viewshed, public sentiment, the presence of threatened and endangered species, and the presence of cultural resources) varies considerably from site to site, especially over the 12-state project area. The PEIS analyzes a reasonably foreseeable development scenario to assess the likely impacts from development following leasing in the planning area. The PEIS will provide the necessary information to support the amendment of land use plans covering those lands where leasing may eventually be proposed (see Section 1.7 – BLM and FS Land Planning Process). The PEIS also provides analysis to allow the FS to more efficiently provide subsequent consent decisions for leasing actions on NFS lands.

Site-specific impacts for subsequent geothermal exploration, drilling, utilization, or reclamation and abandonment would be assessed during the permitting process and in separate NEPA documents prepared by local BLM and FS offices. Such analysis could tier to this document in accordance with NEPA implementation regulations (40 CFR 1502.20).

1.9.2 Scope of Environmental Analysis of Pending Lease Applications

In addition to the programmatic analysis, this PEIS also provides site-specific analysis to inform leasing decisions to be made on 19 pending lease applications located in seven geographical clusters on public and NFS lands. This supplemental analysis is provided in Volume II and is delineated by individual chapters for each geographical cluster. The project and planning areas are specific to the analysis region and are defined in their respective chapters. The analysis focuses on relevant issues and resource concerns in those planning area.

If resources are not expected to be impacted, they are not included in the analysis. The leasing analysis tiers to the programmatic analysis, as appropriate.

1.9.3 Scope of Geographic Information System Data and Graphics

Data from geographic information systems (GIS) have been used in developing acreage calculations and for generating many of the figures. Calculations in the PEIS are rounded and dependent upon the quality and availability of data. Data was collected from a variety of sources including the BLM and FS, and other planning efforts. Given the scale of the programmatic analysis, the compatibility constraints between datasets, and lack of data for some resources, all calculations are approximate and serve for comparison and analytic purposes only. Likewise, the figures are provided for illustrative purposes and subject to the limitations discussed above. Detailed information is available from local BLM and FS offices. Since the publication of the Draft PEIS, additional GIS data were received, including updated land administrative boundaries and the digitizing of the Island Park Geothermal Area. The acres in the Final PEIS have been recalculated and revised accordingly.

1.10 Planning Criteria

In accordance with BLM planning regulations (43 CFR 1610.4-2), planning criteria were developed to help guide data collection, alternative formulation, and impact analysis. Criteria are generally based on laws, regulations, and agency guidance and serve as side-boards to keep the planning process focused.

1. The PEIS will be completed in compliance with the Federal Land Policy and Management Act, the Endangered Species Act, the Clean Water Act, the Clean Air Act, the National Environmental Policy Act and all other applicable laws, Executive Orders and management policies of the BLM.
2. The PEIS will provide the analytical basis for decisions to amend the appropriate individual land use plans as necessary to respond to the potential for increased levels of leasing and development of geothermal resources on BLM-administered lands. Lands open, closed, and open with restrictive stipulations to geothermal leasing will be identified in the affected plans.
3. The PEIS will be limited to addressing leasing and development of geothermal resources, and will not address management of other resources, although the BLM will consider and analyze the impacts on other managed resource values of this increased use. Management of other resources in the planning areas affected will continue to be governed by the applicable RMPs.
4. The RMPs, as amended, will recognize valid existing rights.

5. BLM will coordinate with local, State, Tribal and Federal agencies in the PEIS to strive for consistency with their existing plans and policies, to the extent practicable.
6. BLM will coordinate with Tribal governments and will provide strategies for the protection of recognized traditional uses in the PEIS process.
7. BLM will take into account appropriate protection and management of cultural and historic resources in the PEIS process, and will engage in all required consultation.
8. BLM will recognize in the PEIS the specific niche occupied by public lands in the life of the communities that surround them and in the nation as a whole.
9. BLM will make every effort to encourage public participation throughout the process.
10. BLM has the authority to address lands with wilderness characteristics and describe protective management prescriptions in RMPs. In keeping with the public involvement process that is part of all land use planning efforts, the BLM will consider public input regarding lands to be managed to maintain wilderness characteristics.
11. Environmental protection and energy production are both desirable and necessary objectives of sound land management practices and are not to be considered mutually exclusive priorities.
12. The PEIS will consider and analyze climate change impacts in its land use plans and associated NEPA documents, including the anticipated climate change benefits of geothermal energy.
13. The PEIS will comply with the Geothermal Steam Act, as amended, and the legislative directives set forth in the Energy Policy Act of 2005.
14. Geospatial data will be automated within a GIS to facilitate discussions of the affected environment, formulation of alternatives, analysis of environmental consequences, and display of results.

1.11 Decisions to Be Made

As discussed above, the PEIS contains two distinct scopes, one for the programmatic analysis and one for the pending lease applications. Separate decisions will be made for each scope.

1.11.1 Decisions on the Programmatic Analysis

No sooner than 30 days after the US Environmental Protection Agency (EPA) publishes the Notice of Availability of the Final EIS, the BLM and FS will issue a Record of Decision on the findings of the programmatic analysis. The Record of Decision will include:

- An explanation of the decision, including a discussion of the factors that influenced the decision;
- A summary of the alternatives considered;
- Identification of the environmentally preferable alternative;
- A list of BLM RMPs that would be amended by the action; and
- Documentation of stipulations, best management practices, and procedures that would be adopted for leasing actions or imposed at the development stage.

BLM Decisions Resulting from this PEIS

The signing of the Record of Decision would amend all affected BLM land use plans as discussed in Section 1.7 – BLM and FS Land Planning Process. Amendments would include allocating BLM-administered lands with geothermal resource potential as closed, open, or open with major or moderate constraints to geothermal leasing. This includes establishing a projected new level of potential geothermal development with existing planning level decisions (termed reasonably foreseeable development scenario), and identifying appropriate stipulations, best management practices, and procedures to protect other resource values and uses while providing sufficient pre-leasing analysis to enable the BLM to make future competitive geothermal leasing availability decisions.

Once the plans are amended, the BLM can make decisions whether or not to issue geothermal leases in conformance with the amended land use plan on the basis of this PEIS. Following this amendment process, it is the intent of the BLM that, upon receipt of future nominations or applications for direct use, affected BLM offices would be able to conduct a DNA evaluation to make lease sale decisions without further plan amendments or NEPA analysis, unless special circumstances require additional environmental evaluation. The BLM and FS would conduct other environmental reviews to comply with other laws, including but not limited to the Endangered Species Act and National Historic Preservation Act, prior to issuing leases (see Section 2.2.2 Lease Stipulations, Best Management Practices, and Procedures).

FS Decisions Resulting from this PEIS

For the FS, this PEIS would identify those lands that are legally open or closed to consideration for geothermal leasing on affected NFS lands, along with any terms and conditions. The FS would be able to tier from the PEIS to facilitate future leasing analysis and any allocation or stipulation decisions. For any leasing on NFS lands beyond the specific pending lease applications discussed in Volume II, the FS would still need to provide consent. Prior to providing consent to the BLM the FS generally must identify specific lands that are administratively available for leasing of geothermal resources and under what conditions. In order to make the administrative availability decision the FS generally must prepare an additional NEPA document (leasing analysis). The FS is not proposing to amend any land use plans as part of the proposed action.

Implementation of the proposed action would minimize the delays that currently occur for geothermal leasing, ensure consistency in the leasing process, provide a programmatic basis for future lease-specific consent decisions to leasing on NFS lands, reduce costs, and provide opportunities to tier future site-specific NEPA analyses from the Final PEIS.

BLM Decisions to be Made Following Subsequent NEPA Analysis

Although the BLM expects to be able to rely upon this analysis, combined with DNA evaluations to document NEPA adequacy, to make lease issuance decisions in the near term, the issuance of a lease does not give the lessee the right to proceed with exploration or development (i.e., any surface disturbing activities beyond casual use) in the absence of further site-specific permits with associated environmental analysis. This document does predict a general level of anticipated future geothermal development in BLM areas that have geothermal potential, but it is not intended to provide full analysis of all phases of development. There are several stages of decision making necessary to approve geothermal resource development, each with its own environmental compliance requirements, and this document covers only the land use planning and lease issuance stages.

Forest Service Decisions to be Made Following Subsequent NEPA Analysis

This programmatic analysis does not identify lands for which the FS would or would not consent to the issuance of geothermal leases, with the exception of the pending lease application areas discussed in Volume II. It also does not amend NFS land use plans as may be necessary when the FS decides to consent to the issuance of a geothermal lease for a particular area of land. This PEIS does provide enough analysis to predict likely areas where major and minor stipulations or protective constraints on surface use would be needed, which would facilitate the subsequent NEPA process that would be necessary to provide future leasing consent decisions. Approval of permits allowing any surface disturbing activity generally would be issued following additional site-specific analysis completed after issuance of a geothermal lease.

1.11.2 Decisions on Pending Lease Applications

The BLM and FS will issue separate decisions for each of the seven areas associated with the pending lease applications. This will require execution of Records of Decision separate from the programmatic action. The decision maker for the pending application areas will be the field office manager or forest supervisor, so it is likely that multiple Records of Decision could be signed (e.g., one decision for each of the seven geographical clusters with leasing applications). The decisions may be issued all at once or may be independently released as issues are addressed and other compliance actions are completed (e.g., tribal consultation).

These decision documents are each supported by a narrower and more specific scope of analysis than that which can be provided at the programmatic level for the broader areas of geothermal potential. This analysis is intended to be sufficient to allow BLM and FS managers to determine areas legally and administratively open or closed, and any necessary stipulations or other terms and conditions to protect other resource values that should be attached to leases in the event that the decisions do allow leases to be issued for the pending applications.

The analysis for these seven pending application areas will provide FS leasing analysis, and provide the basis for FS consent decisions related to each individual application covered in this PEIS. The BLM will be able to decide whether or not to issue leases for each of the pending applications, on both NFS and BLM lands, following this PEIS and the associated Record(s) of Decision.

1.11.3 Future Stages of Decision Making and NEPA Analysis for Pending Lease Application Areas

As stated above, the issuance of a lease on pending applications (on either FS or BLM administered lands) does not give the lessee the right to proceed with exploration or development in the absence of further site-specific permits with associated environmental analysis. This document does predict a general level of anticipated future geothermal development in areas that have geothermal potential, but it is not intended to provide full analysis of all phases of development. There are several stages of decision making necessary to approve geothermal resource development, each with its own environmental compliance requirements, and this document covers only the land use planning and lease issuance stages.

1.12 Public Involvement

1.12.1 Scoping Process and Public Review of the Draft PEIS

The NEPA requires an early and open process for determining issues that should be addressed and analyzed in the PEIS to help decision makers implement the proposed action or an alternative. To formally solicit public input, the public scoping period began with the publication of the NOI in the *Federal Register* on June 13, 2007, and continued through August 13, 2007. A project website was launched prior to the beginning of the scoping period and was maintained and expanded throughout scoping. Soon after the scoping period began, project newsletters were mailed to the project mailing list of approximately 1,600 individuals. Public scoping meetings, hosted by the BLM and FS, were held throughout July 2007 in ten cities across the western US, including Alaska. These meetings provided opportunities for the public, local government, tribes, utilities, and other interest groups to learn about the PEIS, to provide input into the development of the PEIS, and to voice their concerns related to potential environmental impacts that should be addressed in the PEIS. Approximately 174 individuals attended the scoping meetings.

The comments received and evaluated during the scoping period were considered in formulating the alternatives and conducting initial impact evaluations. One hundred and one (101) verbal comments were cataloged. Also, 79 written comment submittals were received as comment cards and letters (received by US Mail), email, and facsimile. Public comments received during the scoping period were related to the NEPA process, purpose and need, alternatives, impact analysis, and project coordination. Some comments addressed issues pertinent to geothermal development but were outside the scope of the PEIS. Table 1-4, Summary of the PEIS Public Scoping Comments, summarizes the general themes from the public comments.

Issue identification was used in the PEIS process to develop alternatives and to focus the analysis. A planning issue is a concern regarding management of resources or uses on the public lands that can be addressed in a variety of ways. Based on the analysis of public scoping comments, three planning issues were identified: (1) How will the values and unique resources within special management areas be protected? (2) What actions or restrictions will be needed to avoid or minimize impacts natural resources and to wildlife and their habitat, including sagebrush-obligate species and old growth forest species? (3) How will geothermal leasing and any subsequent development protect and conserve cultural resources?

On June 20, 2008 the Notice of Availability of the Draft PEIS was published in the *Federal Register*. The NOA initiated the 90-day public comment period. The BLM and FS conducted 13 public meetings during July 2008 in the 12 western states to solicit comments. Over 70 organizations, government agencies, industry representatives, and individuals provided unique letters during the comment period. Most of the written submissions contained multiple comments on different topics, and over 500 unique comments were made. In addition, two form letters were submitted. Chapter 6 provides a detailed review of the public comments on the Draft PEIS.

1.12.2 Consultation and Coordination with Tribes

The BLM and FS are consulting with federally recognized Native American Indian Tribes in accordance with Section 106 of the National Historic Preservation Act and Executive Order 13175, Consultation and Coordination with Indian Tribal Governments. Letters were mailed in September 2007 to each tribal executive official of over 400 tribes and pueblos in the western US and Alaska from the Deputy Director of the BLM and Deputy Chief of the Forest Service (see Chapter 6 for the distribution list). The letters documented the PEIS process and detailed the pending lease applications that are being assessed in the PEIS, and invited them to participate in the consultation process. Seven tribes provided a response letter. One letter noted that no lease applications were in their area of interest, four letters requested consultation if any lease applications would fall in their areas of interest, and two letters requested consultation and to help participate in the PEIS process. The consultation process will be ongoing throughout the project.

Table 1-4
Summary of the PEIS Public Scoping Comments

Comments Related to the NEPA Process	
	The BLM and FS should ensure the PEIS conforms to all requirements of NEPA.
	The PEIS should adequately address the cumulative impacts of proposed and future geothermal projects, as well as the need for associated infrastructure.
	The PEIS should be used as tiering document for subsequent, area-specific and site-specific development.
Comments on the Purpose and Need	
	The PEIS should address how the project will satisfy the requirements of policy and regulations such as the Energy Policy Act of 2005.
	The PEIS should clarify the geographic scope of the project, including the process used to designate potential lease areas and areas that will be excluded from leasing analysis.
	The PEIS should clearly define the extent to which the PEIS will cover tribal lands.
	How will the PEIS address individual backlogged leases?
	How will the PEIS define and address future technologies?
	Some comments identified specific areas as potential lease areas or areas that should be excluded.
Comments on Alternatives	
	Alternatives should include the exclusion of sensitive areas, such as special designated lands, including Areas of Critical Environmental Concern, wilderness, and wild and scenic rivers.
	Lands surrounding Yellowstone National Park should be excluded.
	Leasing should only be allowed near existing infrastructure and transmission lines.
Comments on Impact Analysis	
	The PEIS should analyze all potential impacts related to geothermal exploration and development. The most common concerns were effects to wildlife, wildlife habitat, groundwater, and aesthetics.
Comments on Coordination and Consultation	
	Appropriate Federal and state agencies should be included in and consulted throughout the geothermal PEIS process.
	Tribal governments should be involved throughout the process.
	How will the PEIS identify areas of high potential without divulging valuable proprietary information of potential developers who have already identified resources within the areas?
	The scoping period should be extended and additional scoping meeting locations should be added to allow full scoping opportunities.
Comments Outside the Scope of the PEIS	
	The PEIS should be a joint NEPA/California Environmental Quality Act document and should identify the California Environmental Quality Act lead agency.
	The PEIS should assess impacts from development on tribal lands.
	The PEIS should include provisions that detail the necessary enforcement to ensure that reclamation is effectively completed after exploration activities. Agencies should also be obligated to research and disclose the environmental and legal track record of potential geothermal leaseholders.

1.13 Relationship to Bureau of Land Management and Forest Service Policies, Plans, and Programs

The leasing of geothermal resources is subject to a number of Federal, state, and local laws, regulations, and plans. The following section summarizes the most pertinent Federal and state policies, plans, and laws that affect this PEIS.

1.13.1 Federal Land Policy and Management Act of 1976

The FLPMA mandates that multiple use and sustained yield principles govern the management of public lands. The concept of multiple use directs the BLM to manage public lands to best meet the present and future needs of the American people. The FLPMA (Section 103) defines multiple use as "a combination of balanced and diverse resource uses that takes into account the long-term needs of future generations for renewable and nonrenewable resources," and sustained yield as "the achievement and maintenance in perpetuity of a high-level annual or regular periodic output of the various renewable resources of the public lands consistent with multiple use."

As a result of this PEIS, the BLM will amend land use plans to adopt allocations, stipulations, and best management practices to allow for geothermal leasing.

1.13.2 National Forest Management Act of 1976

The National Forest Management Act (NFMA) is the primary statute governing the administration of national forests. The Act expanded and otherwise amended the Forest and Rangeland Renewable Resources Planning Act of 1974, which called for the management of renewable resources on national forest lands. The National Forest Management Act requires the Secretary of Agriculture to assess forest lands, develop a management program based on multiple-use, sustained-yield principles, and implement a resource management plan for each unit of the National Forest System. In doing so, the Secretary must: use an interdisciplinary approach; coordinate with state and local resource management efforts; provide for public participation; and provide for multiple-use and sustained-yield of products and services. The Secretary must revise the management plans whenever significant changes occur in a unit. Each National Forest will use information in the PEIS to determine if its specific resource plan needs to be amended to incorporate geothermal leasing.

1.13.3 National Environmental Policy Act

The NEPA supports a national policy that requires Federal agencies to review the effects of their actions on the quality of the human environment. The review process ensures that the environmental impacts of any Federal or federally funded action is available to public officials and citizens before decisions are made and before actions are taken.

1.13.4 Clean Air Act

The Clean Air Act was passed to regulate air pollution and improve air quality. It regulates air emissions from area, stationary, and mobile sources. This law also authorizes the US EPA to establish National Ambient Air Quality Standards to protect public health and the environment.

1.13.5 Clean Water Act

The Clean Water Act established the basic structure for regulating discharges of pollutants into waters of the US. Also included are requirements to set water quality standards for all contaminants in surface waters. The Clean Water Act made it unlawful for any person to discharge any pollutant from a point source into navigable waters unless a permit was obtained under its provision.

1.13.6 Mining and Mineral Policy Act of 1970

Section 2 of the Mining and Mineral Policy Act of 1970 encourages the development of mineral resources, including geothermal resources, on Federal lands.

1.13.7 Geothermal Steam Act of 1970

The Geothermal Steam Act of 1970, as amended, governs the leasing of geothermal steam and related resources on Federal lands. This Act authorizes the Secretary of the Interior to issue leases for development of geothermal resources and also prohibits leasing on a variety of public lands, such as those administered by USFWS.

1.13.8 Energy Policy Act of 2005

The EPAct of 2005 was intended to establish a comprehensive, long-range domestic energy policy. It provides incentives for traditional energy production as well as newer, more-efficient energy technologies and conservation. It contains several provisions related to geothermal energy to make it more competitive with traditional methods of energy production.

1.13.9 Endangered Species Act

The Endangered Species Act provides for the Federal protection of threatened plants, insects, fish, and wildlife. The USFWS and the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries) administer the Endangered Species Act on behalf of the US. The major components of the Endangered Species Act include:

- Provisions for the listing of threatened and endangered species;
- The requirement for consultation with USFWS and NOAA Fisheries on Federal projects, under certain circumstances;
- Prohibitions against the taking of listed species; and
- Provisions for permits to allow the incidental taking of listed species.

1.13.10 The Migratory Bird Treaty Act of 1918, as Amended

The Migratory Bird Treaty Act makes it unlawful to pursue, hunt, kill, capture, possess, buy, sell, purchase, or barter any migratory bird, including the feathers or other parts, nests, eggs, or migratory bird products. Executive Order 13186, signed January 10, 2001, sets forth the responsibilities of Federal agencies to further implement the provisions of the Migratory Bird Treaty Act by integrating bird conservation principles and practices into agency activities by ensuring that Federal actions evaluate the effects of actions and agency plans on migratory birds.

1.13.11 The Wild Free-Roaming Horse and Burro Act of 1971, as Amended by the Public Rangelands Improvement Act of 1978

This Act provides for the management, protection, and control of wild horses and burros on public lands and authorizes the adoption of wild horses and burros by private individuals.

1.13.12 The Fish and Wildlife Conservation Act of 1980

The Fish and Wildlife Conservation Act of 1980 encourages Federal agencies to conserve and promote the conservation of nongame fish and wildlife species and their habitats.

1.13.13 The Taylor Grazing Act of 1934

The Taylor Grazing Act of 1934 introduced Federal protection and management of public lands by regulating grazing on public lands.

1.13.14 The Public Rangelands Improvement Act of 1978

The Public Rangelands Improvement Act of 1978 requires the BLM to manage, maintain, and improve the condition of the public rangelands so that they become as productive as feasible.

1.13.15 National Historic Preservation Act of 1966, as Amended

The National Historic Preservation Act of 1966 provides for the establishment of the National Register of Historic Places (NRHP) to include historic properties such as districts, sites, buildings, structures, and objects that are significant in American history, architecture, archaeology, and culture. Section 106 of the Act requires Federal agencies with jurisdiction over a proposed Federal project to take into account the effect of the undertaking on cultural resources listed or eligible for listing on the NRHP, and afford the State Historic Preservation Offices and the Advisory Council on Historic Preservation an opportunity to comment regarding the undertaking. The NRHP eligibility criteria have been defined by the Secretary of the Interior's Standards for Evaluation (36 CFR 60).

1.13.16 Alaska National Interest Lands Conservation Act

The Alaska National Interest Lands Conservation Act (ANILCA) was passed in 1980 designating 104 million acres for conservation by establishing or expanding national parks, wildlife refuges, wild and scenic rivers, wilderness areas, forest monuments, conservation areas, recreation areas, and wilderness study areas to preserve them for future generations. Section 810(a) of the ANILCA requires that an evaluation of subsistence uses and needs be completed for any Federal determination to "withdraw, reserve, lease, or otherwise permit the use, occupancy, or disposition of public lands."

1.13.17 Alaska Native Claims Settlement Act

The Alaska Native Claims Settlement Act (ANCSA) was passed by Congress in 1971 to settle aboriginal land claims in Alaska. Under the settlement the Natives received title to a total of over 44 million acres, to be divided among some 220 Native Villages and 12 Regional Corporations established by the act.

1.14 OTHER PLANS AND PROGRAMS

The following plans and programs also apply to geothermal leasing.

1.14.1 State Renewable Portfolio Standard Program

Renewable portfolio standards are state laws requiring electric utility providers to obtain a minimum percentage of their energy from renewable generation sources. These renewable resources include geothermal, wind, solar, hydroelectric, and other renewables such as biomass and tidal. Eight of the twelve states considered in this PEIS have renewable portfolio standard policies in place (Table 1-3, State Renewable Portfolio Standards). Alaska, Idaho, Utah, and Wyoming do not have renewable portfolio standards in place.

1.14.2 State Greenhouse Gas Reductions Laws

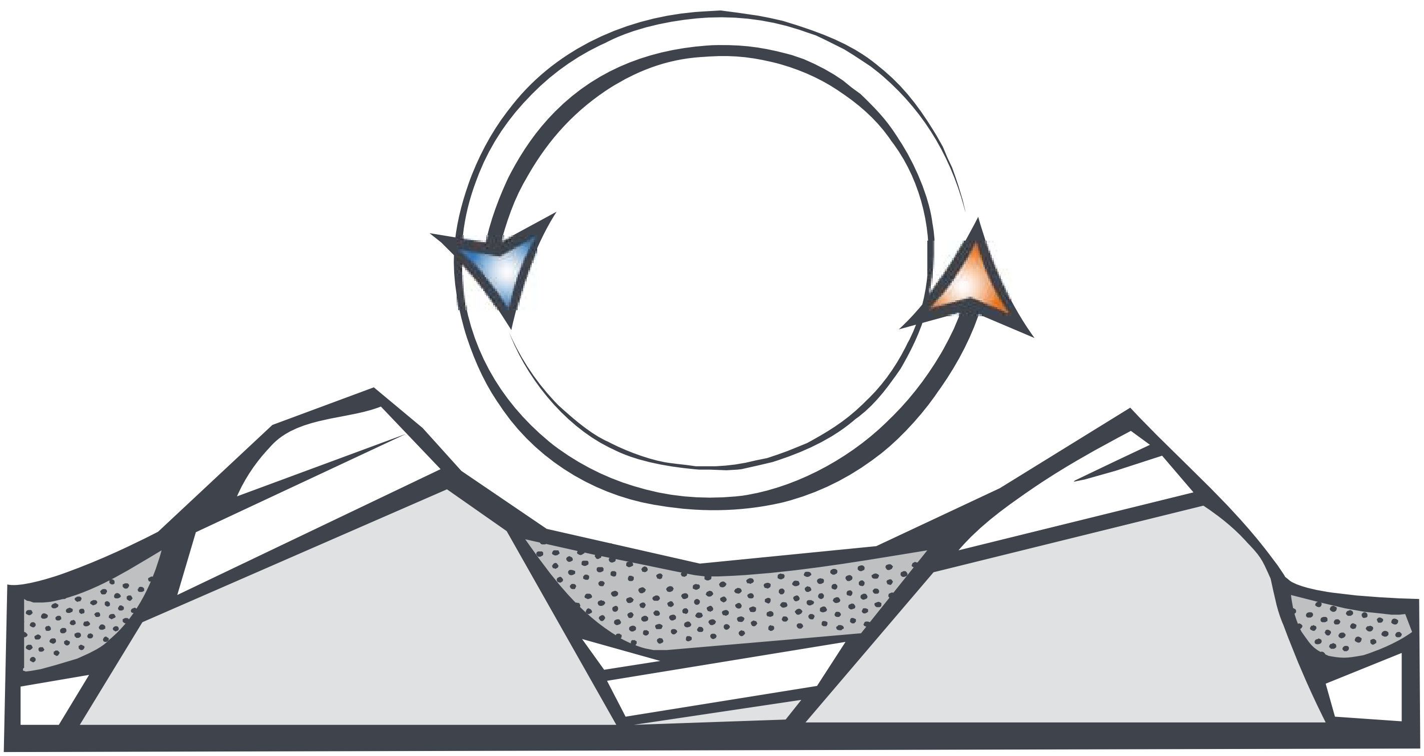
Greenhouse gas reduction laws have been passed in several states in response to the potential threat of climate change. The laws set greenhouse gas reduction goals at future milestones and work in conjunction with state renewable portfolio standards. Greenhouse gas reduction laws work indirectly as an incentive in renewable energy development.

1.14.3 West-wide Energy Corridor Programmatic Environmental Impact Statement

The US DOE, BLM, FS, and US Department of Defense are preparing a PEIS to evaluate issues associated with the designation of energy corridors on Federal lands in 11 western states (US DOE and BLM 2007). Based on the information and analyses developed in this PEIS, each agency would amend its respective land use plans by designating a series of energy corridors. The proposed transmission corridors could provide transmission services to potential geothermal power plants located on public lands addressed for leasing in this PEIS.

1.15 READERS GUIDE TO THE PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

The Programmatic EIS is divided into three volumes. Volume I provides the programmatic environmental impact statement, Volume II provides the supplemental environmental analysis for the pending geothermal lease applications, and Volume III includes the appendices.



CHAPTER 2

PROPOSED ACTION AND ALTERNATIVES

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CHAPTER 2
PROPOSED ACTION AND ALTERNATIVES

2.1 INTRODUCTION

This chapter provides the details of the proposed action, alternatives to the proposed action, a discussion of alternatives considered but eliminated from detailed analysis, and an overview of the reasonably foreseeable development (RFD) scenario for geothermal resources in the western US.

2.2 PROPOSED ACTION

The BLM and FS are proposing to facilitate geothermal leasing on BLM administered public lands and NFS lands that have geothermal potential in the twelve western states, including Alaska. This would be accomplished by the following four specific actions:

- Identify public and NFS lands with geothermal potential as being open or closed to leasing;
- Provide a comprehensive list of stipulations, best management practices, and procedures to serve as consistent guidance for future geothermal leasing and development;
- Amend BLM Resource Management Plans (RMPs) to adopt the RFDs, resource allocations and list of stipulations, best management practices, and procedures; and
- Make decisions to issue or deny geothermal lease applications on BLM and NFS lands pending as of January 1, 2005.

2.2.1 Identify Lands for Leasing

Under this proposed action, all lands in the 12 western states with geothermal potential and administered by the BLM and FS would be identified as being open to geothermal leasing with possible moderate to major constraints or closed to leasing. In the Record of Decision the BLM would amend the appropriate RMPs for these allocations. Figures 2-1 and 2-2 show the BLM Field Office boundaries within the geothermal potential area and Figures 2-3 and 2-4 show National Forests.

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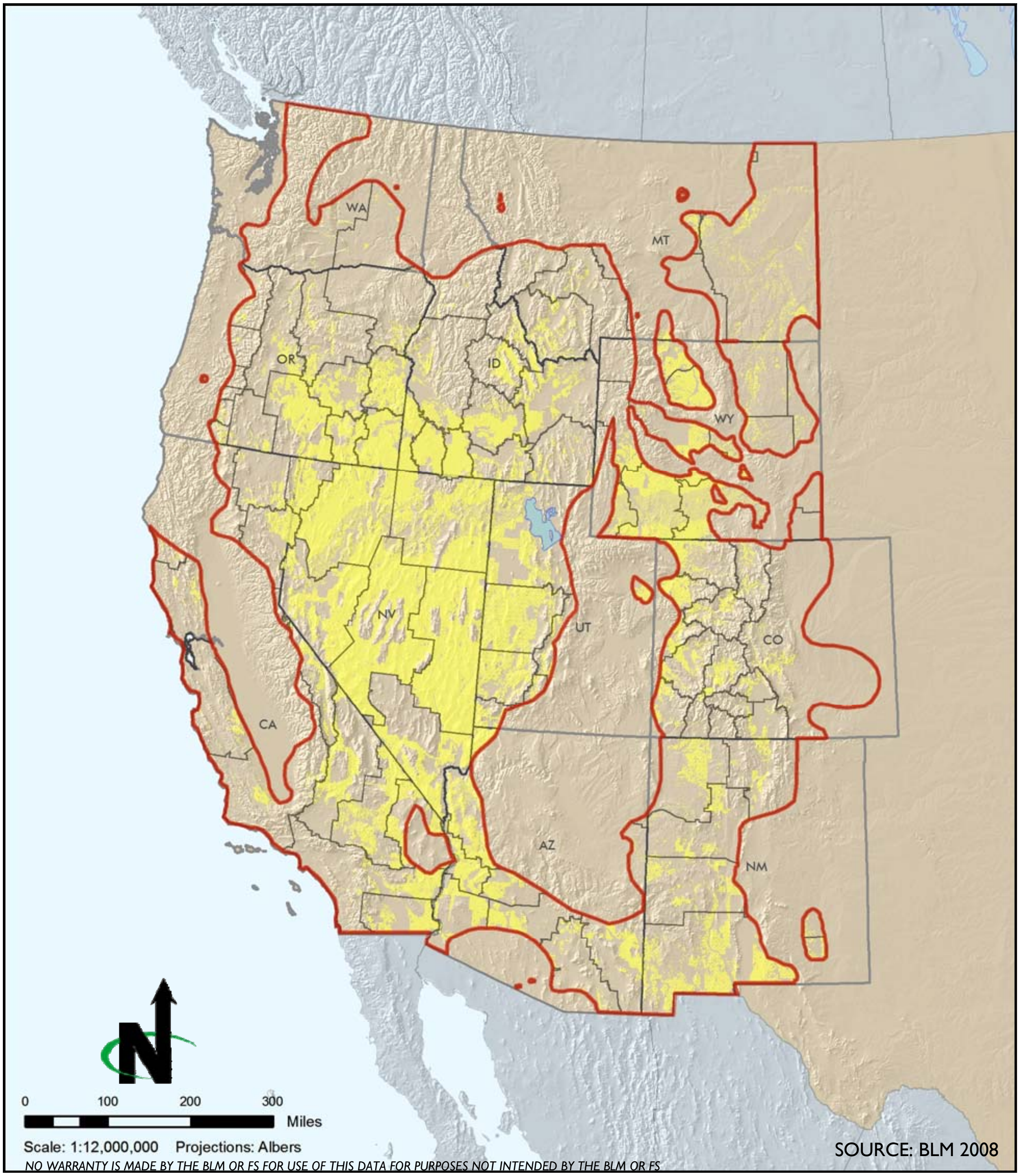


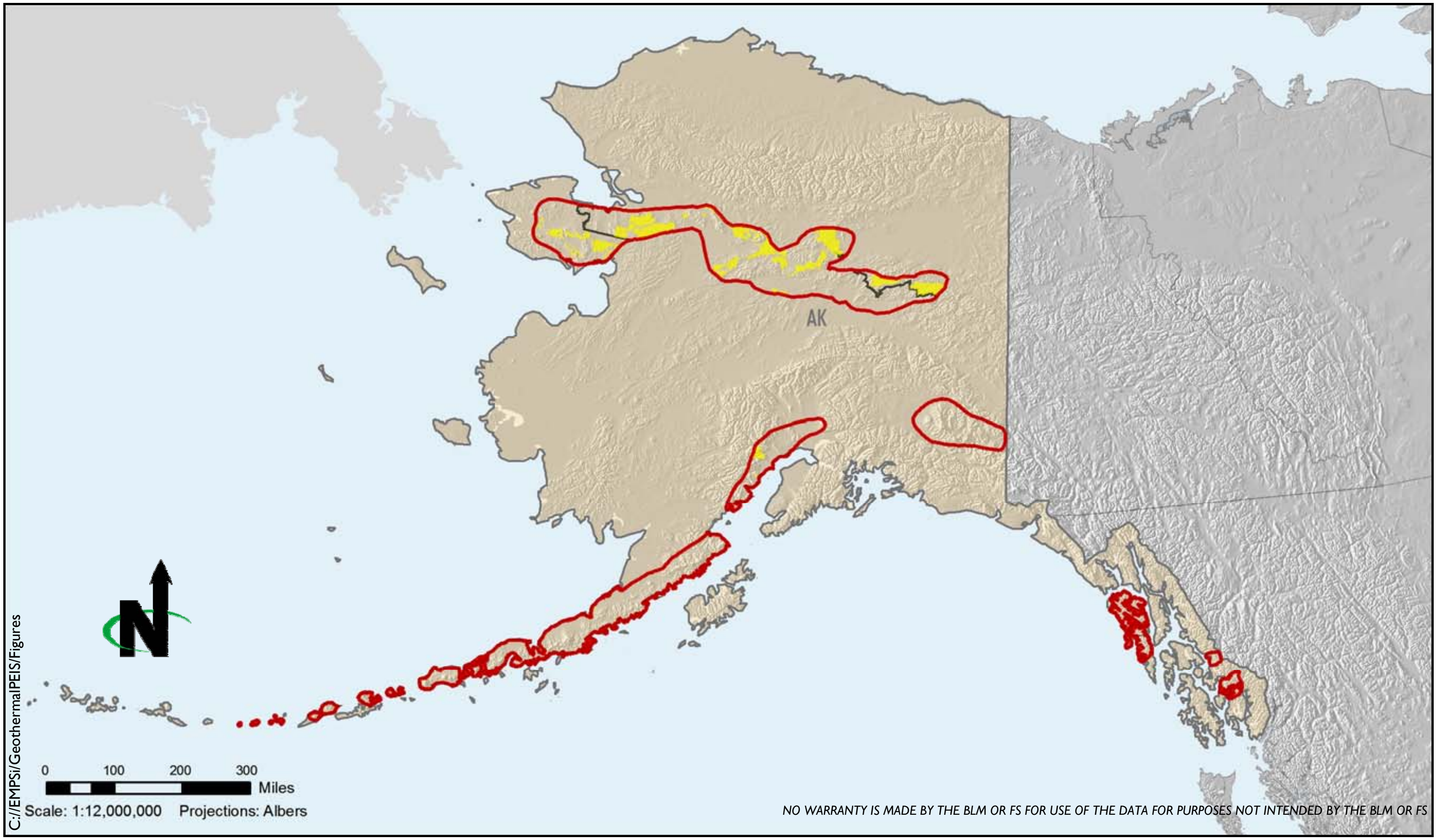
About 137 million acres of public land are within the geothermal potential area in the 11 western states and are administered by 97 field offices.

LEGEND:

- Potential Geothermal Area
- BLM Field Office Boundary
- BLM Public Land

BLM Field Office Boundaries within the Planning Area of the 11 Western States

Figure 2-1



Almost six million acres of public land in Alaska have geothermal potential.

LEGEND:

Potential Geothermal Area

BLM Field Office Boundary

BLM Public Land

BLM Administrative Boundaries in the Planning Area of Alaska

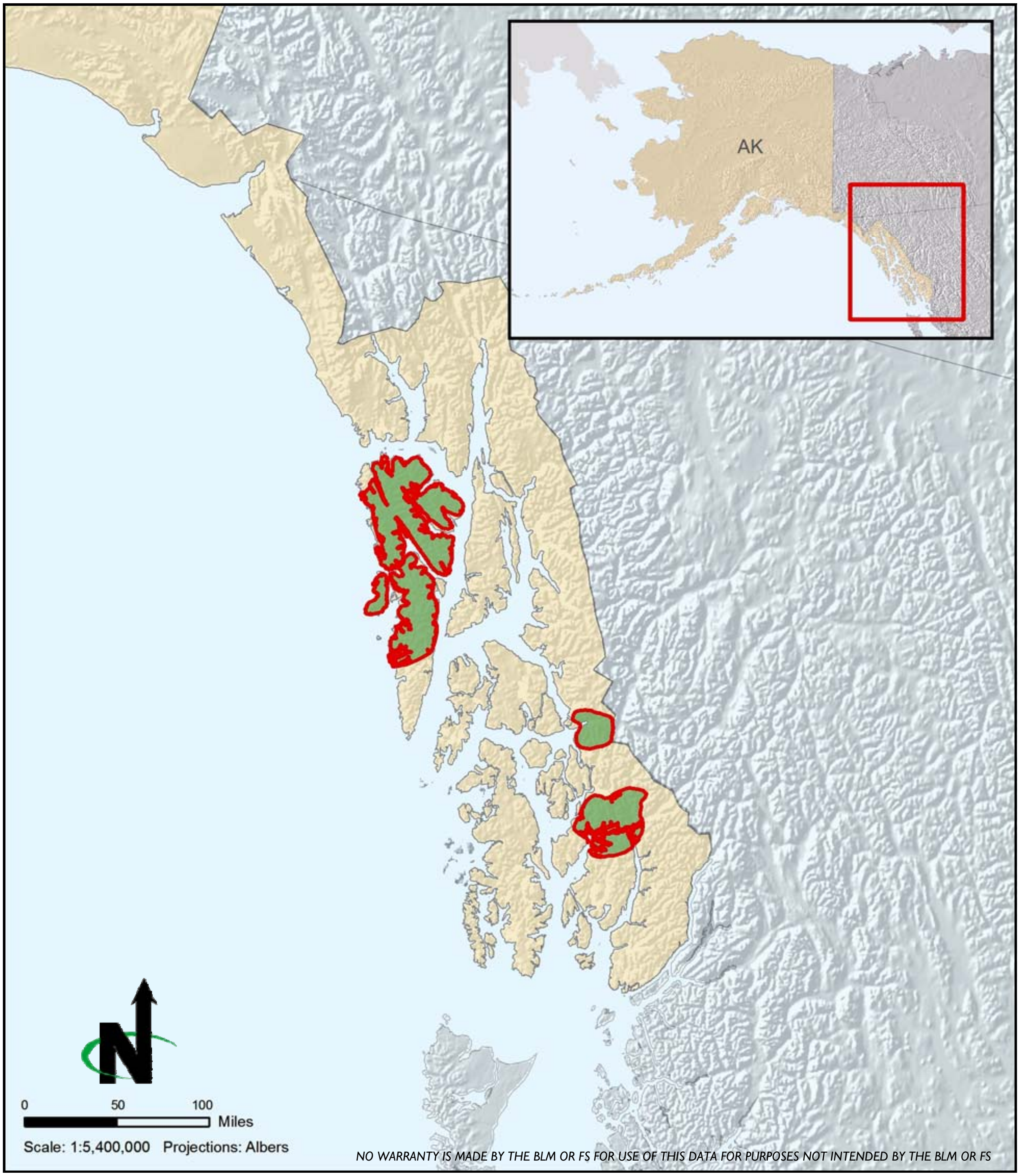
Figure 2-2

Over 101 million acres of NFS lands are within the geothermal potential area in the 11 western states.

LEGEND:
Geothermal potential area
NFS lands

National Forest System Lands and Districts in the Planning Area of the 11 Western States

Figure 2-3



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Almost three million acres of NFS lands within the Tongass National Forest on the Alaskan panhandle have geothermal potential.

LEGEND:

Geothermal potential area

NFS lands

National Forest System Lands in the Planning Area of Alaska

Figure 2-4

The BLM and FS have determined that certain lands within the planning area are excluded from geothermal leasing on the basis of existing laws, regulations (see 43 CFR 3201.11), and Executive Orders. These non-discretionary closures include the following lands administered by the BLM and FS:

- National Monuments.
- National Conservation Areas (NCA) and similar designations with the exception of King Range NCA and Steese NCA.
- Wilderness Areas and National Wilderness Areas.
- Wilderness Study Areas.
- Lands within areas allocated for wilderness or further planning in Executive Communication 1504, Ninety-Sixth Congress (House Document 96-119), unless such lands are allocated to uses other than wilderness by a land and resource management plan or are released to uses other than wilderness by an act of Congress.
- National Recreation Areas.
- Designated Wild Rivers under the Wild and Scenic River Act.
- The Island Park Geothermal Area (includes NFS lands in Idaho and Montana).
- Withdrawn lands under Section 17(d)(1) of the Alaska Native Claims Settlement Act.[1]

As discussed in Chapter 1, there are other lands administered by other Federal agencies that are closed to leasing, including lands managed as part of the National Wildlife Refuge System (16 USC 668 [dd]) and lands within units of the National Park System. Prior to making a leasing decision on lands in proximity to a National Park System unit, the BLM or FS must determine if there would be any impacts to thermal or hydrological features within the unit, in accordance with the Geothermal Steam Act Amendments (30 USC Section 1026).

In addition to non-discretionary closures, the BLM and FS have the administrative authority to issue discretionary closures to protect special resource values. BLM and FS have had a great deal more experience managing lands for development of oil and gas resources, and many more management plans address these resources. Development of oil and gas resources result in many of the same kinds of impacts as development of geothermal resources

[1] Section 17(d)(1) of the Alaska Native Claims Settlement Act (ANCSA) of 1971 authorized the Secretary of the Interior to withdraw and reserve lands for study and classification. These withdrawals closed the lands to disposal and appropriation under public land laws, including mining and mineral leasing laws. The withdrawals remain in effect on about 50 million acres of public land in Alaska. The BLM makes recommendations for revocation of the withdrawals through the planning process, and the Secretary makes the final determination. This PEIS recognizes that most land administered by the BLM in Alaska is withdrawn from geothermal leasing; however, these lands are included for analysis because the Secretary could revoke lands from withdrawal in the future. This PEIS does not make any recommendations on what lands are recommended for revocation from withdrawal; such determinations will be made in the appropriate BLM land use plans.

(e.g., surface disturbance resulting from the footprints of facilities, wells, pads and pipelines, as described in Section 2.5, Reasonably Foreseeable Development Scenario); therefore, BLM and FS have determined that it is appropriate to take an approach to development of geothermal resources similar to that taken to development of oil and gas resources. Areas that require protection from the effects of development of fluid resources are more likely to require protection from the similar effects of development of geothermal resources. Because of this, the BLM has determined that, for ACEC's the management approach to development of oil and gas resources may appropriately serve as a surrogate for development of geothermal resources, absent more explicit geothermal-specific treatment. The following areas are proposed BLM discretionary closures for geothermal leasing; the Forest Service is not proposing to amend any land use plans to make such administrative decisions as part of the Proposed Action (see Section 1.11.1 Decisions on the Programmatic Analysis).

- The California Desert Conservation Area[2].
- Areas of Critical Environmental Concern where the BLM determines that geothermal leasing and development would be incompatible with the purposes for which the ACEC was designated, or those whose management plans expressly preclude new leasing or development for oil and gas or geothermal resources. A list of ACECs that are currently open and closed to fluid mineral leasing is provided in Appendix C. No new closures are proposed.
- Other lands within BLM's National Landscape Conservation System (NLCS), such as National Historic and Scenic Trails.
- National Landmarks and Research Natural Areas.
- Military reservations encompassing public lands are open for development except in instances where geothermal development conflicts directly with the terms of the reservation or the mission as identified by the military.
- Areas previously closed to fluid minerals development in approved land use plans.

Under the Proposed Action approximately 118 million acres of BLM public land would be allocated as open to geothermal leasing subject to existing laws, regulations, formal orders, stipulations attached to the lease form, and the terms and conditions of the standard lease form. While these lands are allocated as open, compliance with laws and regulations could nevertheless prohibit some lands from leasing. For example, if the BLM or FS determines that subsequent exploration, development, or utilization of nominated lands would likely result in a significant adverse effect on a significant thermal feature within a unit of the

[2] Geothermal leasing and development is allowed in designated portions of the California Desert Conservation Area in accordance with the California Desert Conservation Area Plan, 1980, as amended (BLM 1999).

National Park System, the lease would not be issued pursuant to the Geothermal Steam Act Amendments of 1988 (30 USC Section 1026[c]).

The authorized officer retains the discretion to issue stipulations that impose moderate to major constraints on use of surface of any leases in order to mitigate the impacts to other land uses or resources objectives as defined in the guiding resource management plan. In addition, 79 million acres of NFS lands have been identified as not being closed by statute, regulation, or orders, and as such, would be considered for evaluation for leasing.

In total, this represents about 80 percent of public lands and NFS lands within the planning area. Conversely, the non-discretionary and discretionary closures would restrict approximately 25 million acres of BLM public land. About 24 million acres of NFS lands would be closed (by law, regulations, or other authority) to geothermal leasing within the planning area. This represents about 20 percent of all public and NFS lands in the planning area. All of these lands are outside of Alaska except for about 1.8 million acres along the Alaskan panhandle within the Tongass National Forest in the Fairbanks District of the BLM. Tables 2-1 and 2-2 list the approximate acreage of closed areas within each BLM Office and National Forest and Figures 2-5 and 2-6 illustrate the closed and open lands in the 11 western states and in Alaska.

Table 2-1
BLM Public Lands with Geothermal Potential and Proposed Closed Areas to Leasing

State	District or Field Office	Acres within Planning Area	Proposed Acres Closed	State	District or Field Office	Acres within Planning Area	Proposed Acres Closed
AK	Anchorage (District)	992,786	--[1]	CA	El Centro	1,236,466	853,632
AK	Fairbanks (District)	4,867,749	1,444,835[1]	CA	Folsom	274	82
AZ	Arizona Strip	626,291	328,799	CA	Hollister	273,622	29,240
AZ	Hassayampa	701,670	88,515	CA	Needles	1,498,782	1,203,713
AZ	Kingman	2,219,911	373,299	CA	Palm Springs-South Coast	1,555,386	1,017,252
AZ	Lake Havasu	1,352,613	178,621	CA	Redding	51,209	2,954
AZ	Lower Sonoran	860,793	344,285	CA	Ridgecrest	1,831,176	1,296,514
AZ	Safford	1,270,987	90,893	CA	Surprise	1,430,221	397,653
AZ	Tucson	520,812	172,746	CA	Ukiah	264,147	40,333
AZ	Yuma	1,289,013	186,006	CO	Columbine	63,001	2,795
CA	Alturas	502,188	89,093	CO	Del Norte	38,185	9,160
CA	Arcata	83,436	56,341	CO	Dolores	427,661	143,103
CA	Bakersfield	560,591	330,725	CO	Glenwood Springs	567,172	27,717
CA	Barstow	2,892,852	1,488,168	CO	Grand Junction	420,016	66,622
CA	Bishop	747,823	284,029	CO	Gunnison	614,233	164,408
CA	Eagle Lake	1,041,655	407,959	CO	Kremmling	367,370	13,807

Table 2-1
BLM Public Lands with Geothermal Potential and Proposed Closed Areas to Leasing

State	District or Field Office	Acres within Planning Area	Proposed Acres Closed	State	District or Field Office	Acres within Planning Area	Proposed Acres Closed
CO	La Jara	241,147	20,985	NV	Ely	11,418,529	1,241,356
CO	Little Snake	962,205	4,457	NV	Las Vegas	3,426,674	709,582
CO	Pagosa Springs	5,777	699	NV	Winnemucca	8,232,520	546,952
CO	Royal Gorge	661,011	73,627	OR/WA	Andrews	1,604,455	1,006,091
CO	Saguache	235,756	52,516	OR/WA	Ashland	120,365	52,750
CO	Uncompahgre	800,861	130,462	OR/WA	Baker	435,461	44,309
CO	White River	884,343	22,415	OR/WA	Border	99,042	8,439
ID	Bruneau	1,604,986	316,553	OR/WA	Butte Falls	89,148	14
ID	Burley	849,597	70,471	OR/WA	Cascades	138,070	19,008
ID	Challis	908,313	139,652	OR/WA	Central Oregon	899,351	228,336
ID	Cottonwood	90,128	13,963	OR/WA	Deschutes	752,690	66,748
ID	Four Rivers	1,340,695	562,196	OR/WA	Jordan	2,589,122	971,352
ID	Jarbidge	1,565,165	131,547	OR/WA	Klamath Falls	223,594	8,634
ID	Owyhee	1,497,330	303,451	OR/WA	Lakeview	3,202,746	528,942
ID	Pocatello	554,115	44,554	OR/WA	Malheur	2,023,254	309,650
ID	Salmon	520,764	60,464	OR/WA	Three Rivers	1,664,151	48,965
ID	Shoshone	1,904,389	428,425	OR/WA	Upper Willamette	31,923	0
ID	Upper Snake	1,881,331	237,801	OR/WA	Wenatchee	152,054	5,976
MT	Billings	149,410	6,768	UT	Cedar City	2,102,417	23,739
MT	Butte	272,708	35,014	UT	Fillmore	4,310,287	455,524
MT	Dillon	910,199	165,583	UT	Kanab	145,417	15,519
MT	Lewistown	183,749	133	UT	Richfield	400,725	49,649
MT	Malta	4,076	0	UT	Salt Lake	3,066,003	390,815
MT	Miles City	1,863,245	84,618	UT	St. George	468,886	63,378
MT	Missoula	55,344	2,564	UT	Vernal	272,862	0
NM	Carlsbad	186,375	0	WY	Buffalo	571,425	12,301
NM	Farmington	1,421,241	113,860	WY	Casper	517,576	9,160
NM	Las Cruces	5,000,939	523,188	WY	Cody	722,834	39,317
NM	Rio Puerco	978,622	362,255	WY	Kemmerer	693,806	83,508
NM	Roswell	119,750	0	WY	Lander	1,201,201	32,423
NM	Soccoro	1,267,174	299,915	WY	Newcastle	132,922	0
NM	Taos	533,041	144,066	WY	Pinedale	704,239	39,119
NV	Battle Mountain	10,419,122	933,196	WY	Rawlins	2,308,513	72,173
NV	Carson City	4,988,877	677,456	WY	Rock Springs	3,356,775	338,172
NV	Elko	7,505,351	536,717	WY	Worland	1,537,942	91,803
					TOTAL	**143,154,205**	**25,146,569**

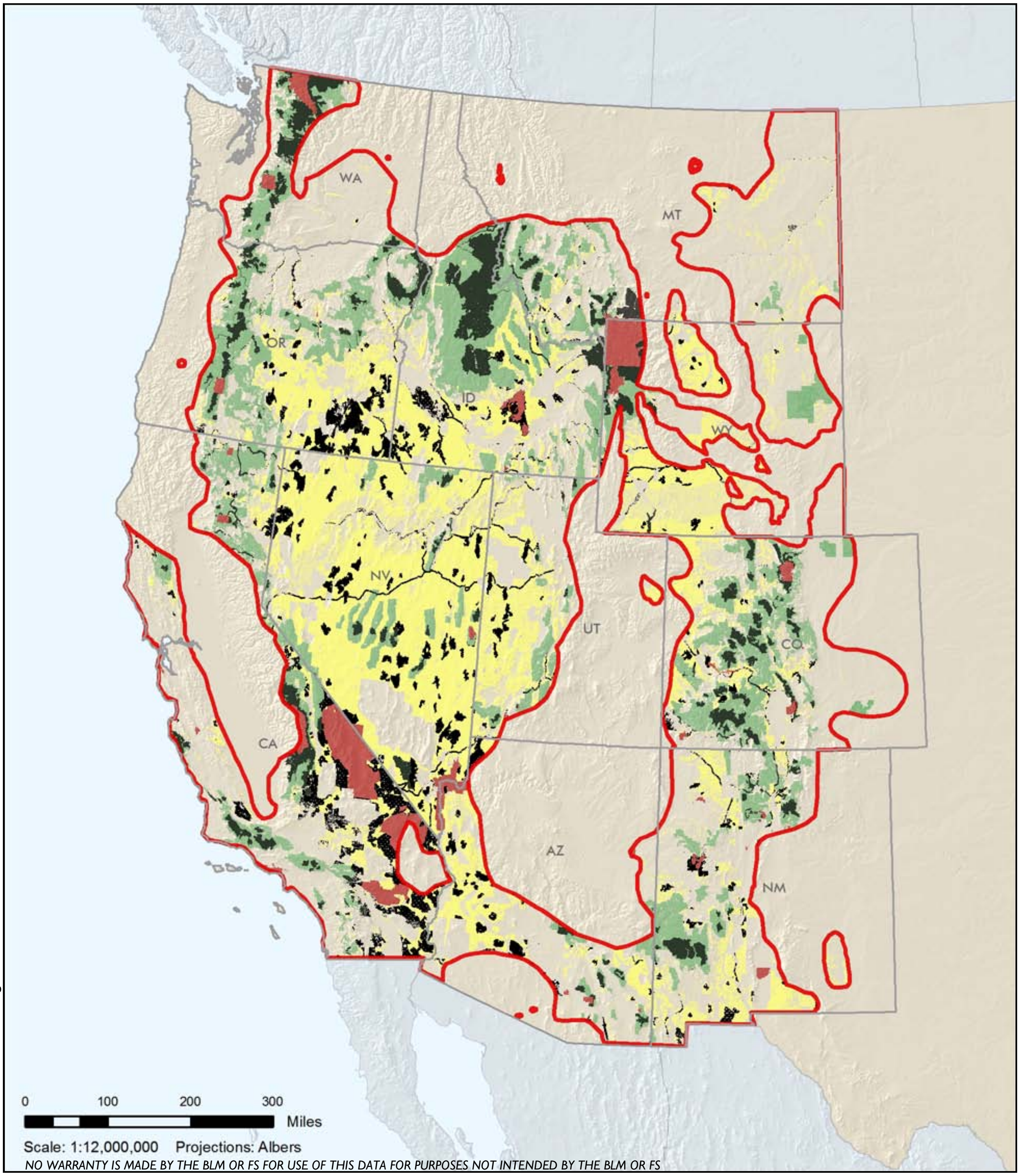
[1] Most of the land administered by the BLM within the planning area of Alaska are withdrawn from mineral leasing under Section 17(d)(1) of the Alaska Native Claims Settlement Act of 1971. The closed acres in this table represent the acreage that would remain closed to geothermal leasing if the Secretary of the Interior revoked the withdrawal from all public lands in the planning area.

Table 2-2
National Forest System Lands with Geothermal Potential and Areas Legally Closed to Geothermal Leasing

National Forest	Acres within Planning Area	Proposed Acres Closed	National Forest	Acres within Planning Area	Proposed Acres Closed
Angeles National Forest	700,526	96,078	Manti-Lasal National Forest	122,731	0
Apache-Sitgreaves National Forests	536,388	4,290	Medicine Bow-Routt National Forest	2,914,429	251,084
Arapaho and Roosevelt National Forests	2,144,801	372,359	Mendocino National Forest	591,785	36,294
Ashley National Forest	103,212	102,345	Modoc National Forest	2,021,948	219,334
Beaverhead-Deerlodge National Forest	3,567,861	432,617	Mt Baker-Snoqualmie National Forest	1,982,319	867,833
Bitterroot National Forest	1,663,506	882,053	Mt. Hood National Forest	1,099,844	391,579
Boise National Forest	2,598,828	64,944	Nez Perce National Forest	2,251,928	1,080,050
Bridger-Teton National Forest	1,952,301	827,311	Ochoco National Forest	1,154,882	42,730
Caribou-Targhee National Forest	3,070,701	662,433	Okanogan-Wenatchee National Forests	2,760,232	1,603,964
Carson National Forest	1,486,469	234,997	Payette National Forest	2,441,522	810,267
Cibola National Forest	1,746,158	103,812	Pike-San Isabel National Forest	2,768,326	425,753
Clearwater National Forest	816,236	386,237	Plumas National Forest	885,039	54,615
Cleveland National Forest	561,166	75,577	Rio Grande National Forest	1,946,489	427,455
Coronado National Forest	1,235,266	346,707	Rogue River-Siskiyou National Forests	476,358	87,619
Custer National Forest	645,473	29,538	Salmon-Challis National Forest	4,330,550	1,237,515
Deschutes National Forest	1,868,469	311,583	San Bernardino National Forest	808,076	142,148
Dixie National Forest	1,005,239	72,117	San Juan National Forest	2,094,174	575,868
Eldorado National Forest	19	0	Santa Fe National Forest	1,590,231	382,810
Fishlake National Forest	982,768	2,022	Sawtooth National Forest	2,189,973	800,234
Fremont-Winema National Forests	2,809,657	127,477	Sequoia National Forest	997,457	475,698
Gallatin National Forest	1,844,331	873,419	Shasta Trinity National Forest	532,564	48,650

Table 2-2
National Forest System Lands with Geothermal Potential and Areas Legally Closed to Geothermal Leasing

National Forest	Acres within Planning Area	Proposed Acres Closed	National Forest	Acres within Planning Area	Proposed Acres Closed
Gifford Pinchot National Forest	1,420,495	300,565	Shoshone National Forest	417,267	231,025
Gila National Forest	3,387,242	851,641	Sierra National Forest	278,345	259,661
Grand Mesa, Uncompahgre and Gunnison National Forests	3,126,701	641,501	Tahoe National Forest	240,795	1,256
Helena National Forest	737,819	7,327	Tongass National Forest	2,732,322	284,967
Humboldt-Toiyabe National Forest	6,487,894	1,249,964	Tonto National Forest	465,533	127,666
Inyo National Forest	1,945,283	653,371	Uinta National Forest	278,551	41,092
Klamath National Forest	358,944	34,226	Umatilla National Forest	1,460,291	304,807
Lassen National Forest	1,353,926	194,251	Umpqua National Forest	492,171	108,973
Lewis and Clark National Forest	31,732	0	Wallowa-Whitman National Forest	2,382,077	886,641
Lincoln National Forest	33,825	0	Wasatch-Cache National Forest	611,876	111,912
Lolo National Forest	347,638	42,112	White River National Forest	2,488,788	748,248
Los Padres National Forest	1,927,933	802,714	Willamette National Forest	1,730,532	422,731
Malheur National Forest	1,543,957	89,150	**TOTAL**	**103,582,163**	**24,365,016**



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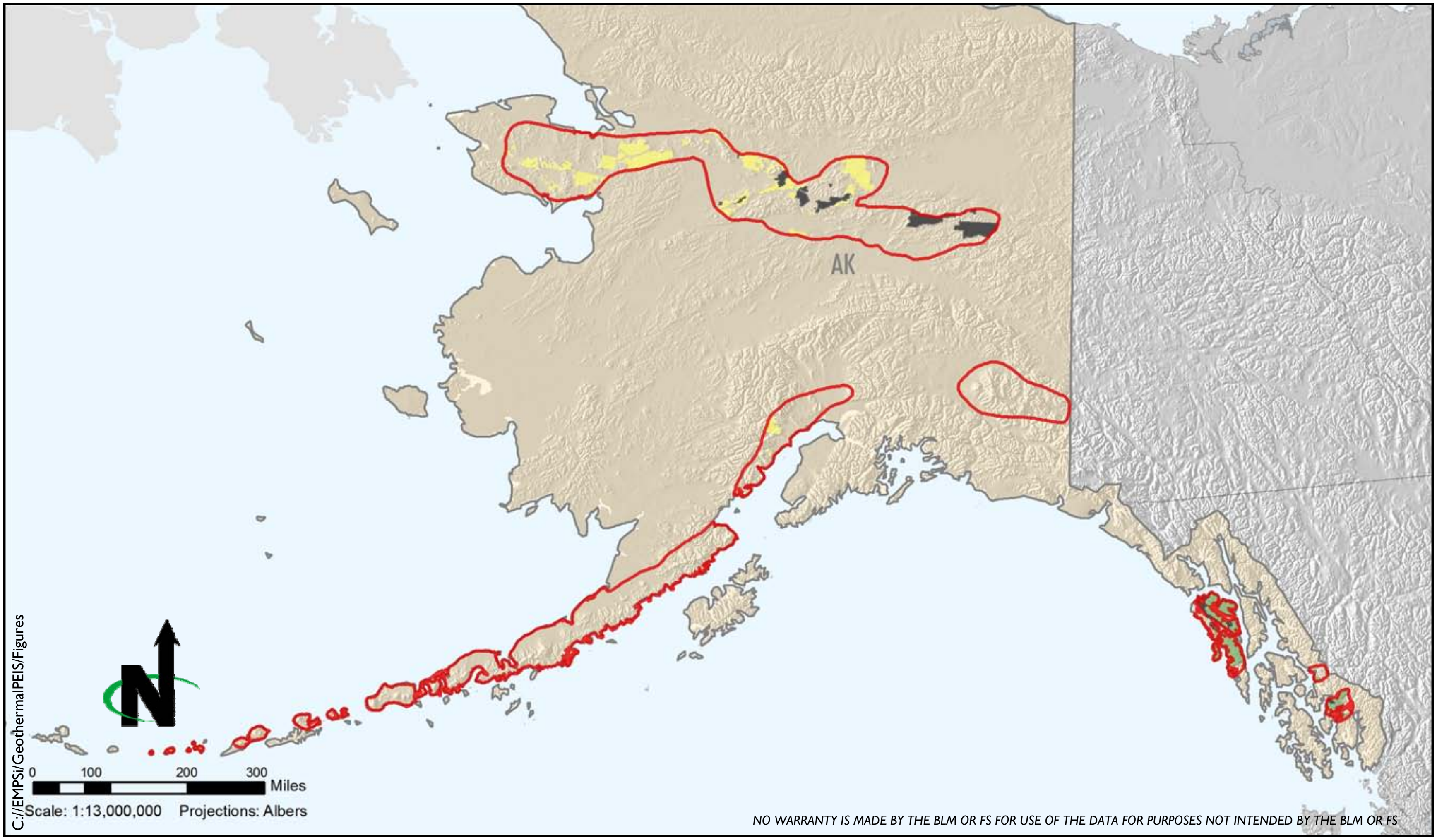
Under the Proposed Action, about 118 million acres of BLM public land and 79 million acres of NFS land would be allocated as open to geothermal leasing. National Park lands are closed.

LEGEND:

- Potential geothermal area
- National Park System Lands Closed to Leasing
- Public Lands Open to Leasing
- NFS Lands Open to Leasing
- Public and NFS Lands Closed to Leasing

BLM Public and NFS Lands Open and Closed in the 11 Western States

Figure 2-5



Under the Proposed Action, about 285,000 acres along the Alaskan panhandle within the Tongass National Forest and about 1.5 million acres in the Fairbanks District of the BLM would be closed to geothermal leasing. All National Park lands are closed.

LEGEND:

- Geothermal potential area
- Public Lands Open to Leasing
- NFS Lands Open to Leasing
- Public and NFS Lands Closed to Leasing

BLM Public and NFS Lands Open and Closed in Alaska

Figure 2-6

2.2.2 Lease Stipulations, Best Management Practices, and Procedures

Lease Stipulations

This section provides the list of constraints that would be applied as appropriate by the authorized officer to any new leases for lands that are available for geothermal leasing. Lease stipulations are major or moderate constraints applied to a new geothermal lease. A lease stipulation is a condition of lease issuance that provides a level of protection for other resource values or land uses by restricting lease operations during certain times or at certain locations or by mitigating unacceptable impacts, to an extent greater than standard lease terms or conditions. A stipulation is an enforceable term of the lease contract, supersedes any inconsistent provisions of the standard lease form, and is attached to and made a part of the lease. Lease stipulations further implement the BLM's regulatory authority to protect resources or resource values.

Local land use plans take different approaches to protect resources depending on the circumstances on those planning areas. Because this is a programmatic document, the geothermal stipulations herein have been developed to address a wide variety of landscapes, climates, and ecosystems, without disrupting the management approach of local land use plans. These stipulations were selected for inclusion based on a comprehensive review of land use plans, program guidance, geothermal development activities, published data on geothermal development impacts, industry standards, and best professional judgment. In addition, other reports on fluid mineral leasing and development (e.g., oil and gas) were consulted because of the similarity of most of the activities and impacts, such as from exploration, drilling, and site development. Where the agency determines that particular stipulations may be inappropriate for a planning area, the procedures for waivers, exception, and modifications would be followed.

Lease Exceptions, Waivers, and Modifications

To ensure leasing decisions remain appropriate in light of continually changing circumstances and new information, the BLM develops and applies lease stipulation exception, waiver, and modification criteria. An exception, waiver, or modification may not be approved unless, (1) the authorized officer determines that the factors leading to the stipulation's inclusion in the lease have changed sufficiently to make the protection provided by the stipulation no longer justified; or (2) the proposed operations would not cause unacceptable impacts. (43 CFR 3101.1-4)

- An **exception** is a one-time exemption for a particular site within the leasehold; exceptions are determined on a case-by-case basis; the stipulation continues to apply to all other sites within the leasehold. An exception is a limited type of waiver.
- A **waiver** is a permanent exemption from a lease stipulation. The stipulation no longer applies anywhere within the leasehold.

- A **modification** is a change to the provisions of a lease stipulation, either temporarily or for the term of the lease. Depending on the specific modification, the stipulation may or may not apply to all sites within the leasehold to which the restrictive criteria are applied.

An exception, waiver, or modification may be approved if the record shows that circumstances or relative resource values have changed or that the lessee can demonstrate that operations can be conducted without causing unacceptable impacts and that less restrictive requirements would meet resource management objectives.

The authorized officer may require the operator to submit a written request for an exception, waiver, or modification and information demonstrating that (1) the factors leading to the inclusion of the stipulation in the lease have changed sufficiently to make the protection provided by the lease stipulation no longer justified or (2) that the proposed operation would not cause unacceptable impacts. Requests from the operator should contain, at a minimum, a plan including related on-site or off-site mitigation efforts, to adequately protect affected resources; data collection and monitoring efforts; and timeframes for initiation and completion of construction, drilling, and completion operations. The operator's request may be included in a permit application (e.g., application for permit to drill), Notice of Staking, Sundry Notice, or letter. The BLM may also initiate the process.

During the review process, coordination with other state or Federal agencies would be undertaken, as appropriate, and documented. For example, it may be appropriate to coordinate the review of wildlife exceptions, waivers, and modifications with the local office of the State wildlife agency. Staff review and recommendations would be documented along with any necessary mitigation and provided to the authorized officer for approval or disapproval. The applicant would then be provided with a written notification of the decision.

Public notification (30-day public review) is generally not required for exceptions because an exception is seldom a substantial modification or waiver of a lease term or stipulation (43 CFR 3101.1-4), particularly if the exception criteria is outlined in the lease or the land use plan. Nor is public review required for waivers or modifications that the authorized officer determines are not substantial and do not substantially waive or modify the terms of the lease. "Substantial" in this case would include the exception, waiver, or modification having a "substantial" effect on the environment that was not previously considered. However, the applicable land use plan may contain additional notification requirements. The public notice, if required, should include identification of the modified lease terms and a description of the affected lands or a map.

When Public Notice is appropriate, the following procedures may apply:

- Approval of an exception, waiver, or modification with the permit approval: A notice describing the modified lease terms, when required, may be posted for 30 days in the BLM office; posted on the BLM website; posted in a local paper as a legal notice or incorporated into a newspaper article; or the notice may be included as part of the NEPA document's public review, if the NEPA document is offered for review.
- Approval after the permit has been approved: Public notice, if required, may take the form of a 30-day posting on the BLM website, a legal notice or article in the newspaper, or a notice and associated public review conducted as part of the public review of a NEPA document.
- Approval after drilling has commenced: Unless specified in the land use plan, it is unlikely public notification would be necessary.

The BLM must analyze and document how the exception, waiver, or modification is in conformance with the land use plan and identify the plan decision (including goals, objectives, or desired outcomes) supported by the proposed exception, waiver, or modification. If existing NEPA analysis does not support the exception, waiver, or modification, the BLM must conduct the appropriate environmental review and NEPA analysis. If the proposed exception, waiver or modification is not in conformance with the land use plan or that document does not disclose the conditions under which such proposed change would be allowed, BLM must either amend the plan or deny the exception, waiver, or modification.

It may be necessary to add, delete, or modify lease stipulations in the land use plan as a result of pre-lease issuance parcel reviews, statewide lease stipulation consistency reviews, plan amendments, changed circumstances on the ground, or changed resource protection priorities. This is accomplished and documented either through the plan maintenance process (for minor changes consistent with an approved land use plan) or the plan amendment process (for changes resulting in modification of terms, conditions, or decisions in an approved land use plan).

Applicability of Stipulations

Stipulations provided in this PEIS would serve as the minimal level of protection and would be adopted into local land use plans upon signing of the ROD. For example, if an administrative unit has eligible wild and scenic rivers, the wild river stipulation would apply. If an existing land use plan offers more protective measures or has resource specific commitments (e.g., memorandum of understanding for cultural resources), those more protective measures would apply instead. Existing land use plans would also be used to help identify locations of applicability, buffer sizes, and timing conditions for the stipulations.

No Surface Occupancy Lease Stipulations

No Surface Occupancy (NSO) stipulations are considered a major constraint as they do not allow for surface development. For example, a lessee of a NSO area must develop any surface infrastructure outside the NSO area and would need to use advanced technology, such as directional drilling, to access the geothermal resource under the NSO area. These NSO stipulations are applied to the standard lease form as condition of the lease. An NSO is appropriate when the standard terms and conditions, other less restrictive lease stipulations (see below), and best management practices for permit approval (Appendix D) are determined to be insufficient to achieve the resource protection objectives.

- Designated or proposed critical habitat for listed species under the Endangered Species Act of 1973 (as amended) if it would adversely modify the habitat. For listed or proposed species without designated habitat, NSO would be implemented to the extent necessary to avoid jeopardy.
- Within the boundary of properties designated or eligible for the National Register of Historic Places, including National Landmarks and National Register Districts and Sites; and additional lands outside the designated boundaries to the extent necessary to protect values where the setting and integrity is critical to their designation or eligibility.
- Areas with important cultural and archaeological resources, such as traditional cultural properties and Native American sacred sites, as identified through consultation.
- Water bodies, riparian areas, wetlands, playas, and 100-year floodplains.
- Developed recreational facilities, special-use permit recreation sites (e.g., ski resorts and camps), and areas with significant recreational use with which geothermal development is deemed incompatible; excluding direct use applications.
- Designated National Scenic and Recreational Rivers under the Wild and Scenic River Act.
- Segments of rivers determined to be potentially eligible for Wild and Scenic Rivers (WSR) status by virtue of a WSR inventory, including a corridor of 0.25 miles from the high water mark on either side of the bank[3].

[3] A number of land use plans are currently undergoing revision, and as part of that process WSR inventories have been undertaken. Where a river or river segment has been found to be "eligible" for inclusion in the WSR system as part of one of these inventories, the BLM has the obligation to protect the lands along the eligible segment until a "suitability" determination has been made as part of the land use planning process. If the river or river segment is found to be "non-suitable," the lands along the river then would be available for other uses. If a river or river segment is determined to be suitable for inclusion in the WSR system, the BLM will forward that recommendation to Congress for action and will continue to protect the lands along the river.

- Designated important viewsheds, including (1) public lands designated as VRM Class I and (2) NFS lands with a Scenery Management System integrity level of Very High.
- Slopes in excess of 40 percent and/or soils with high erosion potential.
- Areas that are defined as having special resource values for subsistence needs in Alaska.

Additional NSO stipulations could be applied in conformance with the local land use plan to address site-specific resource concerns.

Timing Limitations and Controlled Surface Use Lease Stipulations

Where standard lease terms and permit-level decisions are deemed insufficient to protect sensitive resources but where an NSO is deemed overly restrictive, the BLM and FS would apply seasonal or time limited (TL) stipulations or controlled surface use (CSU) stipulations to leases. In general, timing limitations are used to protect resources that are sensitive to disturbance during certain periods. Such stipulations are generally applicable to specific areas, seasons, and resources. They are commonly applied to wildlife activities and habitat, such as winter range for deer, elk, and moose; nesting habitat for raptors and migratory birds; and breeding areas. Buffer zones are also used to further mitigate impacts from any human activities. The size of buffers can also be specific to species and location, and can change based on findings of science or movement of species. Therefore, timing limitations would be applied by the authorizing officer as appropriate for the specific lease areas and in compliance with the unit's resource management plan. The BLM and FS would consult with the appropriate agencies (e.g., state wildlife agencies) in establishing the periods and extent of area for timing limitations.

A CSU allows the BLM and FS to require any future activity or development be modified or relocated from the proposed location if necessary to achieve resource protection. The project applicant will be required to submit a plan to meet the resource management objectives through special design, construction, operation, mitigation, or reclamation measures, and/or relocation. Unless the plan is approved, no surface occupancy would be allowed on the lease. The following CSUs would be applied by the authorizing officer as appropriate for the specific area and site conditions.

- ***Protection of riparian and wetland habitat.*** This stipulation would be applied within 500 feet of riparian or wetland vegetation to protect the values and functions of these areas. Measures required will be based on the nature, extent, and value of the area potentially affected.
- ***Protection of visual resources.*** This stipulation would be applied to BLM VRM Class II areas (VRM Class III management objectives

would be met through conditions of approval applied during the permit approval process, and may be referenced in a lease notice); NFS lands with a Scenery Management System integrity level of High; and other sensitive viewsheds, such as within the visual setting of National Scenic and Historic Trails or near residential areas.

- ***Protection of recreational areas.*** This stipulation would be applied to minimize the potential for adverse impacts to recreational values, both motorized and non-motorized, and the natural settings associated with the recreational activity.
- ***Compatibility with urban interface.*** This stipulation would be applied to minimize the potential for adverse impacts to residential areas, schools, or other adjacent urban land uses.
- ***Protection of erosive soils and soils on slopes greater then 30 percent.*** This stipulation would be applied to minimize the potential for adverse impacts to erosive soils as defined as severe or very severe erosion classes based on Natural Resources Conservation Service (NRCS) mapping.
- ***Protection of important habitat and migration corridors***. This stipulation would be applied to protect the continuity of migration corridors and important habitat.

Other Lease Stipulations

Protection of Geothermal Features

Under the following situations, the BLM or FS would apply stipulations to protect the integrity of geothermal resource features, such as springs and geysers. If it is determined that geothermal operations are reasonably likely to result in a significant adverse effect to such a feature, then BLM would decline to issue the lease.

- The BLM or FS would include stipulations to protect any significant thermal features of a National Park System unit that could be adversely affected by geothermal development. These stipulations will be added, if necessary, when the lease or permit is issued, extended, renewed or modified (43 CFR 3201.10[b]).
- Any leases that contain thermal features (e.g., springs or surface expressions) would have a stipulation requiring monitoring of the thermal features during any exploration, development, and production of the lease to ensure that there are no impacts to water quality or quantity.

Endangered Species Act Stipulation

In accordance with BLM Instruction Memorandum No. 2002-174, the BLM will apply the following stipulation on any leases where threatened, endangered, or other special status species or critical habitat is known or strongly suspected. Additionally, the BLM will provide a separate notification through a lease notice to prospective lessees identifying the particular special status species that are present on the lease parcel offered.

> "The lease area may now or hereafter contain plants, animals, or their habitats determined to be threatened, endangered, or other special status species. BLM may recommend modifications to exploration and development proposals to further its conservation and management objective to avoid BLM-approved activity that will contribute to a need to list such a species or their habitat. BLM may require modifications to or disapprove proposed activity that is likely to result in jeopardy to the continued existence of a proposed or listed threatened or endangered species or result in the destruction or adverse modification of a designated or proposed critical habitat. BLM will not approve any ground-disturbing activity that may affect any such species or critical habitat until it completes its obligations under applicable requirements of the Endangered Species Act as amended, 16 USC 1531 et seq., including completion of any required procedure for conference or consultation."

Sensitive Species Stipulation

For agency designated sensitive species (e.g., sage grouse), a lease stipulation (NSO, CSU, or TL) would be imposed for those portions of high value/key/crucial species habitat where other existing measures are inadequate to meet agency management objectives.

Cultural Resources Stipulation

In accordance with BLM Instruction Memorandum No. 2005-003, the BLM will apply the following stipulation to protect cultural resources:

> "This lease may be found to contain historic properties and/or resources protected under the National Historic Preservation Act (NHPA), American Indian Religious Freedom Act, Native American Graves Protection and Repatriation Act, E.O. 13007, or other statutes and executive orders. The BLM will not approve any ground disturbing activities that may affect any such properties or resources until it completes its obligations under applicable requirements of the NHPA and other authorities. The BLM may require modification to exploration or development proposals to protect such properties, or disapprove any activity that is likely to result in adverse effects that cannot be successfully avoided, minimized or mitigated."

Roadless Area Stipulation

The FS manages about 51,477,000 acres of land in the planning area that is designated as inventoried roadless areas. A non-discretionary restriction would be placed on any leases within NFS inventoried roadless areas. Specifically, no new road construction or reconstruction would be allowed in designated roadless areas. If future legislation or regulation change the roadless area designation, the restriction would be revised along with any appropriate environmental review.

Best Management Practices

In addition to lease stipulations, during any subsequent exploration, drilling, utilization, or reclamation and abandonment of geothermal resources, the BLM and FS would require project-specific mitigation measures (Appendix D) to permits. The agency's first priority is to mitigate impacts on-site. When the agency determines that impacts cannot be mitigated to an acceptable level on-site, it may be necessary to deny the permit, ask the applicant to modify the proposal, or mitigate remaining impacts off-site. Best Management Practices are state-of-the-art mitigation measures and may be incorporated into the permit application by the lessee or may be included in the approved use authorization by the BLM as conditions of approval. Conditions of approval are not lease stipulations, but they are site-specific and enforceable requirements to minimize, mitigate, or prevent impacts to resource values from an intended operation. Conditions of approval can limit or amend the specific actions proposed by the operator.

Monitoring

Mitigation measures, including lease stipulations and conditions of approval as well as the general operation of geothermal developments, would be monitored by the lessee or the appropriate Federal agency to ensure their continued effectiveness through all phases of development. Using adaptive management strategies, where mitigation measures are determined to be ineffective at meeting the desired resource conditions, the BLM and FS would take steps to determine the cause and require the operator to take corrective action. This information would also be used to inform future geothermal leasing and development.

Procedures Prior to Leasing

To ensure compliance with regulations and Federal laws, the following procedures would be implemented prior to any lands being included in a competitive lease sale. Stipulations listed above would also be used to help achieve resource protection in accordance with laws and regulations.

- The FS will be consulted and provide a consent determination (including terms and conditions or stipulations) to the BLM prior to any parcels on NFS lands being offered for lease sale. As a condition of consent to the issuance of any lease, the Forest Service would be consulted on the development of a surface use plan.
- The authorized officer of the BLM or FS would consult with the appropriate Native American Tribal governments and Alaska Natives to identify tribal interests and traditional cultural resources

or properties that may be affected by the Federal land leases and potential for geothermal energy development. Tribal interests include economic rights such as Indian trust assets and resource uses and access guaranteed by treaty rights. Traditional cultural resources or properties include areas of cultural importance to contemporary communities, such as sacred sites or resource gathering areas. There may be issues related to the presence of cultural properties, access rights, disruption to traditional cultural practices, cultural use of hot springs and water sources and impacts to visual resources important to tribes. Areas proposed for leasing may include lands where there are tribal interests and traditional cultural resources that are not currently identified. Consultations on leases should include a full disclosure of the lease as a commitment of the land that may eventually involve future development that could preclude other tribal uses. Consideration and research should be directed to determine if there are other ethnic and social groups that may have traditional uses or ties to the lands proposed for leases.

- The authorized officer of the BLM or FS would consult with the appropriate Native American Tribes, Alaska Natives, and State Historic Preservation Officers regarding historic and cultural resources per Section 106 of the National Historical Preservation Act. The presence of archaeological sites and historic properties would be determined on the basis of a records search and literature review of recorded sites and properties in the proposed lease area and a buffer around the lease area, if appropriate. The BLM or FS would assess the adequacy of the cultural resource identification and evaluation effort for the leasing stage. Additional historical, cultural or ethnographic research, consultation and/or inventories may be required to identify resources, determine effects, mitigate adverse effects and complete the Section 106 process. This PEIS addresses the Section 106 process at a programmatic level and serves as a basis for the phased consultation process. All existing memorandums of understanding and agreements regarding the identification and protection of cultural resources would remain valid.
- The authorized officer of the BLM or FS would determine if any listed or proposed threatened or endangered species or critical habitat is present on nominated lease parcels. If so, the authorized officer would comply with Section 7 of the Endangered Species Act, which may include consultation or conferencing with the US Fish and Wildlife Service and/or NOAA Fisheries. Additional consultation would occur during the site-specific project permitting process.

- The authorized officer of the BLM or FS would review the lands for any other sensitive resources (e.g., paleontological, BLM sensitive status species, and FS species of local concern) and provide for the necessary stipulations to protect these resources and ensure compliance with the land use plan. Assessment of the resource would include consulting with agency experts, coordinating with other appropriate agencies, and site surveys if warranted.
- During the processing of any lease nomination or application in Alaska, the authorized officer of the BLM or FS would conduct and document a site-specific analysis of the effects of the lease on subsistence uses and needs in accordance with Section 810(a) of the ANILCA.
- Prior to making a leasing decision on lands in proximity to a National Park System unit, the BLM or FS would coordinate with the National Park Service to determine if there would be any impacts to thermal or hydrological features within the unit. In accordance with the Geothermal Steam Act Amendments (30 USC Section 1026), if it is determined based on scientific evidence that exploration, development, or utilization of the lands subject to the lease application or nomination is reasonably likely to result in a significant adverse effect on a significant thermal feature within the National Park System, the lease would not be issued. In the event that development is reasonably likely to adversely affect a significant thermal feature, the BLM would apply the appropriate stipulations to protect the park units (see Protection of Geothermal Features stipulations above).
- Prior to making leasing decisions, the BLM will assess the adequacy of existing NEPA documentation (i.e., through completion of a DNA) to determine if there is new information or new circumstances that warrant further analysis. For example, additional NEPA analysis may be required in light of new information, or a potential change in management approach regarding resources identified for special management (e.g., travel management planning or areas under consideration by BLM for management for wilderness characteristics).
- The level of environmental analysis to be required under NEPA for subsequent individual exploration, development, and production permits will be determined at the Field Office and FS unit level. In certain instances, it may be determined that a tiered environmental assessment (EA) is appropriate in lieu of an EIS. To the extent that land use plans or this PEIS anticipates issues and concerns associated with individual projects, including potential cumulative impacts, the BLM and FS will tier from land use plans and/or the

PEIS analysis and decisions; thereby limiting the required scope and effort of additional project-specific NEPA analysis.

- The authorized officer of the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states manage and typically have regulatory authority for water quality, water rights, and wildlife.
- Applicants for geothermal development and production on public or NFS lands shall develop a project-specific operations plan that incorporates the applicable mitigation and best management practices provided in Appendix D and, as appropriate, the requirements of other existing and relevant BLM and FS mitigation guidance. Additional mitigation measures will be incorporated into the operations plan and into the conditions of approval or project stipulations. The operations plan will include site plans, location of facilities, wells, pipelines, transmission lines, roads, and other infrastructure.

2.2.3 Amend BLM Land Use Plans

The BLM is proposing to amend specific BLM land use plans for lands with potential developable geothermal resources to incorporate the allocations, stipulations, and procedures detailed above. The plans proposed for amendments are identified in Table 2-3.

Table 2-3
Land Use Plans Proposed for Amendment under the PEIS

State	District or Field Office†	Land Use Plan(s)
AK	Anchorage	Ring of Fire RMP
	Central Yukon	Central Yukon RMP
	East Interior	Kobuk-Seward RMP
AZ	Arizona Strip	Arizona Strip RMP
	Kingman	Kingman RMP
	Lake Havasu	Lake Havasu RMP
	Yuma	Lower Gila South RMP* Yuma RMP*
	Safford	Safford RMP
	Tucson	Safford RMP Phoenix RMP*
	Hassayampa	Lower Gila North MFP*; Phoenix RMP*
	Lower Sonoran	Phoenix RMP* Lower Gila South RMP*

Table 2-3
Land Use Plans Proposed for Amendment under the PEIS

State	District or Field Office†	Land Use Plan(s)
CA	Barstow	West Mojave RMP
	El Centro	E. San Diego County RMP
	Palm Springs-S. Coast	South Coast RMP*
	Alturas	Alturas RMP Cedar Creek/Tule Mountain Integrated RMP*
	Arcata	Arcata RMP Headwaters RMP
	Bakersfield	Caliente RMP* Hollister RMP
	Bishop	Bishop RMP
	Eagle Lake	Eagle Lake RMP
	Hollister	S. Diablo Mountain Range and Central Coast RMP
	Redding	Redding RMP
	Surprise	Surprise RMP
CO	Columbine	San Juan/San Miguel RMP*/Glenwood Springs RMP*
	Delores	San Juan/San Miguel RMP*
	Glenwood Springs	Glenwood Springs RMP*
	Grand Junction	Grand Junction RMP*
	Gunnison	Gunnison RMP
	Kremmling	Kremmling RMP*
	Little Snake	Little Snake RMP*
	Pagosa Springs	San Juan/San Miguel RMP*
	Royal Gorge	Northeast RMP Royal Gorge RMP
	Uncompahgre	Uncompahgre Basin RMP* San Juan/San Miguel RMP*
	White River	White River RMP
ID	Bruneau	Bruneau MFP
	Four Rivers	Cascade RMP* Kuna MFP* Jarbidge RMP*
	Owyhee	Owyhee RMP
	Cottonwood	Chief Joseph MFP*
	Challis	Challis RMP
	Pocatello	Malad MFP* Pocatello RMP*
	Salmon	Lemhi RMP
	Upper Snake	Big Desert MFP* Big Lost MFP* Little Lost-Birch MFP* Medicine Lodge RMP*
	Burley	Cassia RMP Twin Falls MFP Monument RMP

Table 2-3
Land Use Plans Proposed for Amendment under the PEIS

State	District or Field Office†	Land Use Plan(s)
ID (cont.)	Jarbidge	Jarbidge RMP*
	Shoshone	Bennett Hills/ Timmerman Hills MFP Magic MFP Monument RMP Sun Valley MFP
MT	Billings	Billings Resource Area RMP*
	Butte	North Headwaters RMP*
	Dillon	Dillon RMP
	Lewistown	Judith Valley Phillips RMP*
	Malta	West HiLine RMP*
	Miles City	Big Dry RMP* Powder River Resource Area RMP*
	Missoula	Garnet Resource Area RMP
NV	Battle Mtn	Shoshone-Eureka RMP Tonopah RMP
	Carson City	Carson City Consolidated RMP
	Elko	Elko RMP Wells RMP
	Las Vegas	Las Vegas RMP
	Winnemucca	Paradise-Denio MFP* Sonoma-Gerlach MFP*
NM	Rio Puerco	Rio Puerco RMP*
	Soccoro	Socorro RMP*
	Farmington	Farmington RMP
	Taos	Taos RMP*
	Las Cruces	MacGregor Range RMP Mimbres RMP* White Sands RMP
	Carlsbad	Carlsbad RMP
	Roswell	Roswell RMP
OR	Burns†	Three Rivers RMP
	Eugene†	Eugene District RMP*
	Medford†	Medford RMP*
	Prineville†	Two Rivers RMP* Brothers/LaPine RMP* John Day RMP* John Day River MP* Lower Deschutes RMP
	Roseburg†	Roseburg RMP*
	Salem†	Salem RMP*

Table 2-3
Land Use Plans Proposed for Amendment under the PEIS

State	District or Field Office†	Land Use Plan(s)
UT	Cedar City	Cedar Beaver Garfield Antimony RMP Pinyon MFP
	Fillmore	House Range Resource Area RMP Warm Springs Resource Area RMP
	Kanab	Paria MFP* Vermilion MFP* Zion MFP*
	Richfield	Mountain Valley MFP* Henry Mountain MFP* Parker Mountain MFP*
	Salt Lake	Box Elder RMP Iso-tract MFP Park City MFP Pony Express RMP Randolph MFP
	St. George	St. George (formerly Dixie) RMP
	Vernal	Book Cliffs MFP* Diamond Mountain RMP*
WA	Spokane†	Spokane RMP
WY	Buffalo	Buffalo RMP
	Casper	Platte River RMP*
	Cody	Big Horn Basin RMP Cody RMP*
	Kemmerer	Kemmerer RMP*
	Lander	Lander RMP*
	Newcastle	Newcastle RMP
	Pinedale	Pinedale RMP* Snake River RMP
	Rawlins	Great Divide RMP* Green River RMP*
	Rock Springs	Green River RMP*
	Worland	Grass Creek RMP* Waskakie RMP*

MP = Management Plan; MFP = Management Framework Plan; RMP = Resource Management Plan
* = Plans are under revision but the record of decision has not been signed and is not expected until after the record of decision for this PEIS. These field offices could elect to amend their existing RMP/MFP with the decisions in this PEIS until their RMP record of decision is signed.
† = Oregon and Washington Districts manage RMPs in their respective states.

Proposed amendments include (1) adoption of the proposed resource allocations of lands being open or closed to geothermal leasing (see Section 2.2.1) at the level of use indicated in the RFD (see Section 2.5); and (2) adoption of moderate and major constraints on use (stipulations and best management practices) and procedures appropriate for resource values present, for leasing as outlined in Section 2.2.2.

The rationale for amending these plans includes the following:

- The land use plan does not address geothermal leasing.
- The land use plan does not allocate areas as being open or closed to geothermal leasing.
- The land use plan does not assess the reasonably foreseeable development scenario for geothermal development, or the analysis requires updating.
- The land use plan does not have adequate or appropriate stipulations or best management practices to apply to geothermal leases to protect sensitive resources.

Some plans within the 12-state project area were excluded from amendment under this PEIS for a variety of reasons, including the following: (1) the plan falls outside of the area with geothermal potential, (2) the plan was previously amended or revised to adequately address geothermal leasing and development, (3) the plan currently is being amended or revised in a separate NEPA review and that amendment or revision will address geothermal leasing and development, or (4) some other reason(s) exist(s) to exclude the plan from amendment under this PEIS (e.g., a plan revision is scheduled in the foreseeable future and there is likely little interest in geothermal leasing for the area in the near term). As land use plans are revised, the BLM would incorporate the proposed geothermal stipulations, procedures, BMPs, and analysis contained in this PEIS, as appropriate.

2.2.4 Pending Lease Applications

The Energy Policy Act of 2005 requires that the Secretary of the Interior and the Secretary of Agriculture enter into a Memorandum of Understanding (see Appendix B) regarding coordination of leasing and permitting for geothermal development of public lands and National Forest System lands under their respective jurisdictions and further:

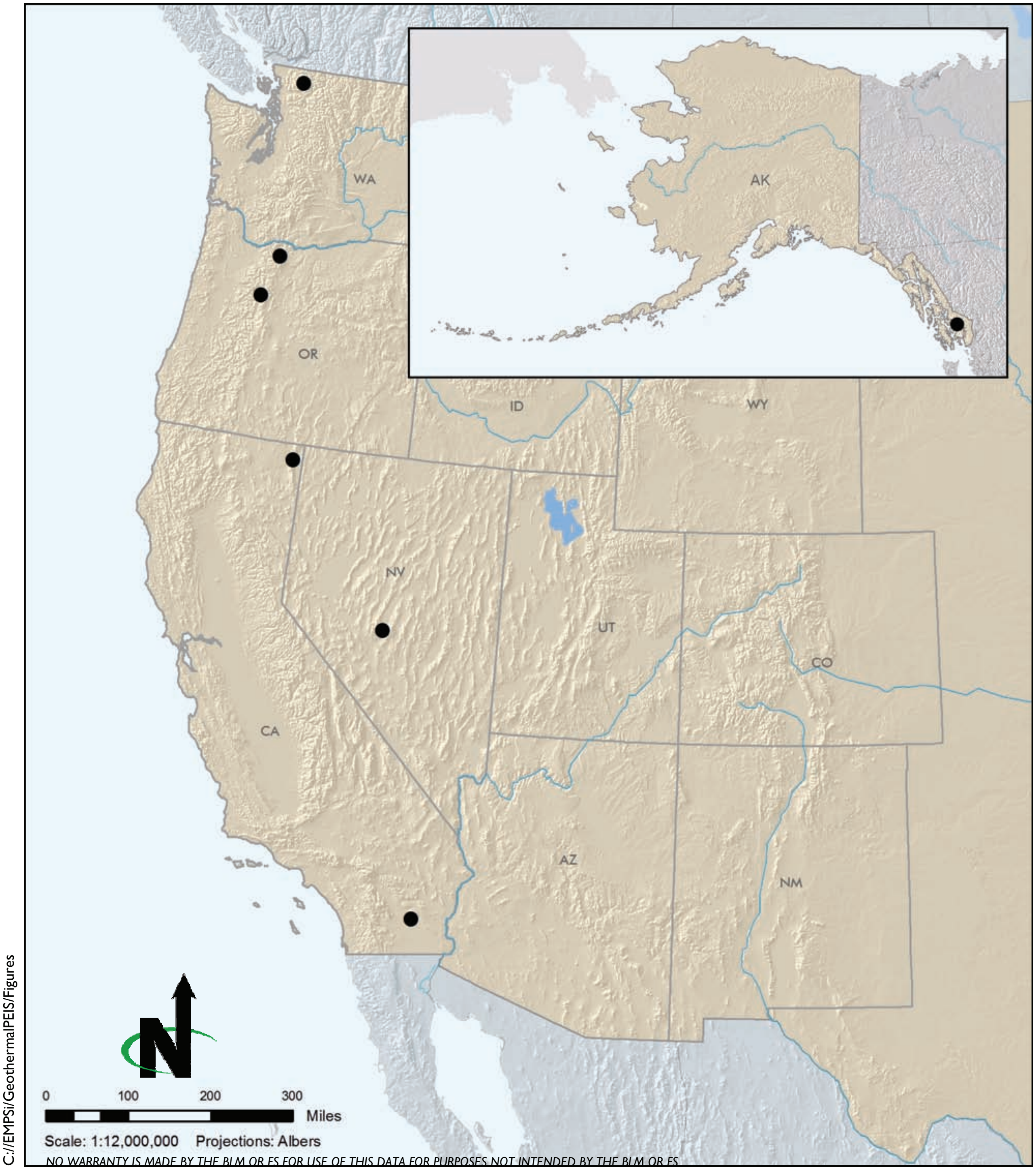
> "that the Memorandum of Understanding shall establish a program reducing the backlog of geothermal lease application pending on January 1, 2005, by 90 percent within the 5-year period beginning on the date of enactment of this Act, including, as necessary, by issuing leases, rejecting lease applications for failure to comply with the provisions of the regulations under which they were filed, or determining that an original applicant (or the applicant's assigns, heirs, or estate) is no longer interested in pursuing the lease application."

As of January 1, 2005, there were 194 pending lease applications; 130 on BLM public lands and 64 on NFS lands (Clarke 2006). Since January 1, 2005 the BLM and FS have processed or resolved many of the lease applications. Based on a detailed review of the status of pending leases, the BLM and FS have identified a total of 19 lease applications that require site-specific analysis in this PEIS to inform decisions to be made on whether to issue the lease or deny the application. Chapter 10 provides more details on the status of pending leases. These 19 leases are grouped together in seven geographic clusters (Table 2-4 and Figure 2-7). Two of the leases are on public lands administered by the BLM, 16 are on NFS lands, and one is on both public and NFS lands.

Under the proposed action, the FS would provide consent determinations for lease applications on NFS lands, and the BLM would issue the leases to the geothermal lease applicants. Separate decisions could be issued for each of the 19 leases, and lease boundaries could be adjusted in the decision to avoid unacceptable impacts to sensitive resources. The analysis of the lease areas is provided in Volume II.

Table 2-4
Pending Lease Applications (Prior to January 1, 2005)

Group	State	BLM or FS Office	Serial Number	Acres
1	AK	Tongass NF	AKAA 084543	2560
1	AK	Tongass NF	AKAA 084544	2560
1	AK	Tongass NF	AKAA 084545	2560
2	CA	El Centro FO	CACA 046142	2161
2	CA	El Centro FO	CACA 043965	1160
3	CA	Modoc NF	CACA 042989	480
3	CA	Modoc NF	CACA 043744	2560
3	CA	Modoc NF	CACA 043745	2560
4	NV	Battle Mtn FO and Humboldt-Toiyabe NF	NVN 074289	605
5	OR	Mount Hood NF	OROR 017049	1538
5	OR	Mount Hood NF	OROR 017051	2480
5	OR	Mount Hood NF	OROR 017052	2480
5	OR	Mount Hood NF	OROR 017053	1376
5	OR	Mount Hood NF	OROR 017327	1294
6	OR	Willamette NF	OROR 054587	1115
7	WA	Mt Baker NF	WAOR 056025	2403
7	WA	Mt Baker NF	WAOR 056027	2560
7	WA	Mt Baker NF	WAOR 056028	2544
7	WA	Mt Baker NF	WAOR 056029	1941



There are 19 pending noncompetitive lease application sites in seven different geographic areas evaluated in the PEIS. These are addressed in Volume II.

LEGEND:

● Pending lease application site

Evaluated Pending Lease Site Areas in the in the 11 Western States and Alaska

Figure 2-7

2.3 ALTERNATIVES

Three alternatives are evaluated in detail in the PEIS, the no action alternative and two action alternatives. Each is discussed below. A comparison of the action alternatives is presented in Table 2-5.

Table 2-5
Comparison of Geothermal Resource Allocations between the Action Alternatives

	Alternative B: Proposed Action (acres)	Alternative C: Leasing Near Transmission Lines (acres)
Public Lands in Planning Area	143,154,205	143,154,205
NFS Lands in Planning Area	103,582,163	103,582,163
Public Lands Open to Indirect Use[1]	118,007,636	61,202,746
Public Lands Open to Leasing for Direct Uses	118,007,636	118,007,636
NFS Lands Open to Leasing for Indirect Use[1]	79,217,147	37,870,654
NFS Lands Open to Leasing for Direct Uses	79,217,147	79,217,147
Public Lands Closed to Indirect Use[1]	25,146,569	81,951,459
Public Lands Closed to Leasing for Direct Uses	25,146,569	25,146,569
NFS Lands Closed to Leasing for Indirect Use[1]	24,365,016	65,711,509
NFS Lands Closed to Leasing for Direct Uses	24,365,016	24,365,016

[1] Indirect use includes commercial electrical generation.

2.3.1 Alternative A: No Action

Alternative A is the no action alternative. Under this alternative, no BLM land use plans would be amended and the existing plan decisions, stipulations, and allocations would not change as a direct result of the PEIS process. Therefore, any plans that do not address geothermal leasing would not be amended and the public lands would not be allocated as open or closed to geothermal leasing.

Processing of pending geothermal lease applications would continue; however, they would be evaluated on a case-by-case basis using analysis in the existing land use plans. Likewise, impacts on lands nominated in the future for leasing would be evaluated using analysis in existing land use plans. This could require additional NEPA documentation and possibly amendments to the plans. Many plans currently do not address geothermal leasing, do not have allocation decisions for geothermal leasing, and/or do not have appropriate RFDs on geothermal leasing. Taking no action would not facilitate the leasing process and does not meet the stated purpose and need; however, it is analyzed in detail to provide a baseline from which to evaluate the other alternatives in accordance with CEQ guidance.

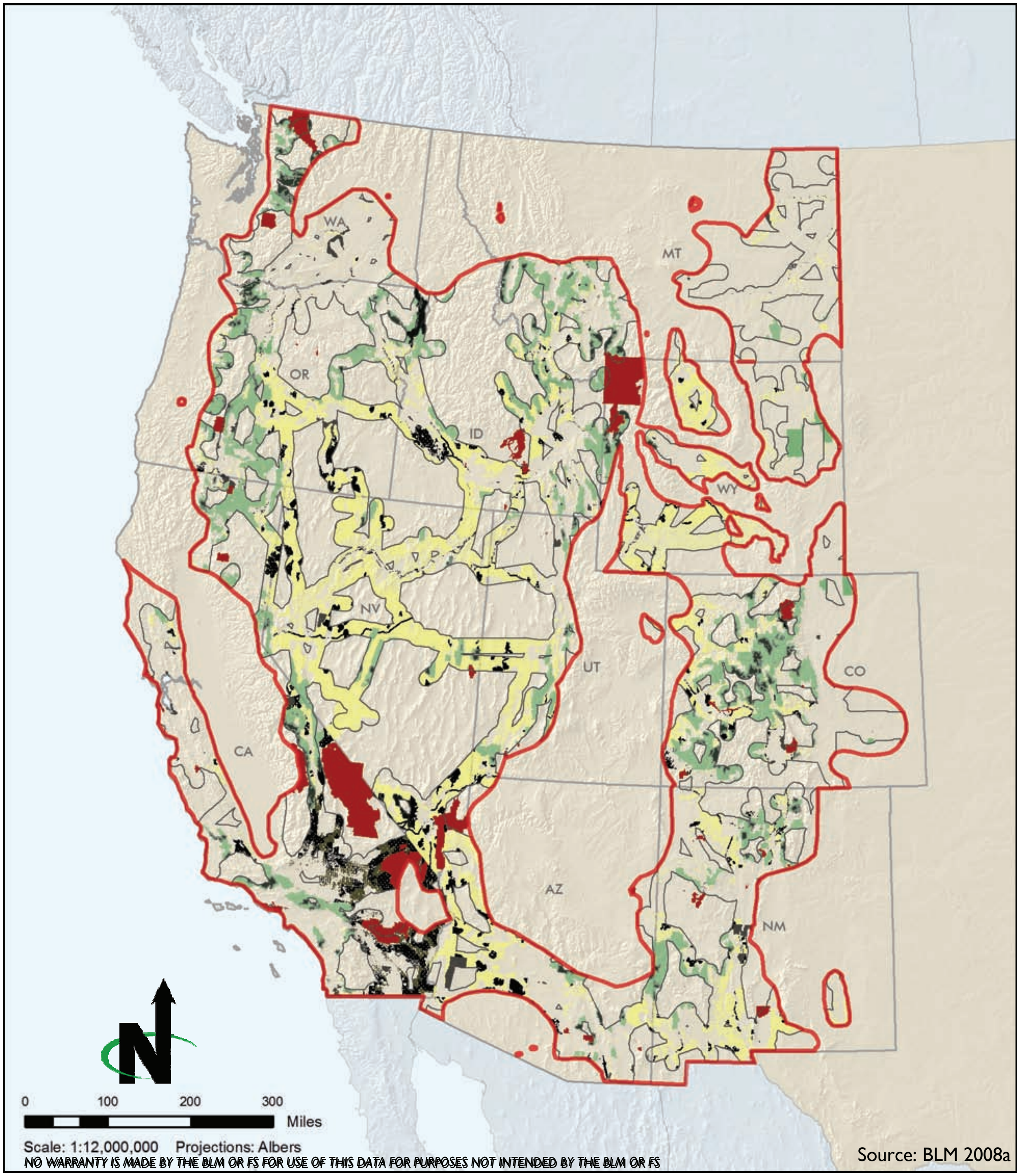
2.3.2 Alternative B: Proposed Action (Preferred Alternative)

As discussed above (Section 2.2 – Proposed Action) approximately 118 million acres of public land would be allocated as open and 79 million acres of NSF land would be legally open to geothermal leasing for direct and indirect use subject to existing laws, regulations, formal orders, stipulations attached to the lease form, and the terms and conditions of the standard lease form. The authorized officer retains the discretion to issue leases with stipulations that impose moderate to major constraints on use of surface of any leases in order to mitigate the impacts to other land uses or resource objectives as defined in the guiding resource management plan. This represents about 80 percent of public lands and NFS lands within the planning area. The remaining 25 million acres of public land and 24 million acres of NFS lands in the planning area would be closed to geothermal leasing. The closed areas encompass non-discretionary and discretionary (BLM only) determinations, including the statutorily closed Island Park Geothermal Area. This area encompasses over 470,000 acres of NFS and public lands around the west and southwest boundaries of Yellowstone National Park for the explicit purpose of protecting the geothermal features of the Park. The BLM would amend 122 land use plans to adopt the allocations, RFDs, and specific stipulations, best management practices, and procedures. Based on the analysis contained in the PEIS and public comments on the Draft PEIS, the BLM has selected Alternative B as the Preferred Alternative.

2.3.3 Alternative C: Leasing Lands near Transmission Lines

Under Alternative C, the BLM and FS would only consider leasing lands for commercial electrical generation if they are within a 20-mile corridor (10-mile from centerline) from existing transmission lines and lines currently under development at 60kV to 500kV (Figure 2-8). All lands within this corridor would be designated as closed or open with moderate to major constraints to leasing using the criteria outlined for the Proposed Action. Island Park Geothermal Area would also be closed (as with Alternative B); however, the restricted area would be expanded to include no leasing within 15 miles from the boundary of Yellowstone National Park. Given the limited transmission line grid and demand for localized power sources for remote communities, the lands available for geothermal leasing in Alaska would be the same as for Alternative B - Proposed Action. Leases for direct use would be considered for the entire planning area and would not be constrained by the location of transmission lines. Therefore, direct use leasing would be the same as the proposed action.

Under this alternative, approximately 61 million acres of public land and 38 million acres of NFS lands would be open for geothermal leasing for commercial



C://EMPSi/GeothermalPEIS/Figures

Under Alternative C, only BLM public and NFS lands near transmission lines would be available for leasing for commercial electrical generation. Direct use and Alaska would be the same as the Proposed Action.

LEGEND:

- Potential geothermal area
- National Park System Lands Closed to Leasing
- Public Lands Open to Leasing
- NFS Lands Open to Leasing
- Public and NFS Lands Closed to Leasing

Alternative C: BLM Public and NFS Lands Near Transmission Lines

Figure 2-8

electrical generation. These lands would be subject to moderate to major constraints as detailed in the Proposed Action. This alternative would increase the amount of land that would be unavailable for geothermal leasing with in the planning area; specifically, about 81 million acres of public land and 66 million acres of NFS lands would be closed. Other lands outside the corridor would not be closed to leasing, but would have to be evaluated on a case-by-case basis as described under the No Action Alternative. This alternative was developed in response to written and verbal recommendations during public scoping.

2.4 Alternatives Considered but Eliminated from Detailed Study

2.4.1 No Leasing or Development of Geothermal Resources on Public or NFS Lands

The No Lease Alternative would not allow leasing of any geothermal resources. Under this alternative, all pending and future geothermal lease applications and nominations would not be approved so as to preclude any and all environmental consequences. This alternative was considered but eliminated from detailed analysis because it violates the multiple-use provisions of FLPMA and is inconsistent with the President's National Energy Policy, the Energy Policy Act of 2005, and Executive Order 13212. Consequently, the No Lease Alternative was not carried forward for detailed analysis.

2.5 Reasonably Foreseeable Development Scenario

The following reasonably foreseeable development (RFD) scenario serves as a basis for analyzing environmental impacts resulting from future leasing and development of Federal geothermal resources within the western US over the next 20 years. A variety of factors (e.g., economic, social, and political) are beyond the control of the BLM and FS and will influence the demand for geothermal resources. Therefore, the RFD scenario is a best professional estimate of what may occur if public and NFS lands are leased. It is not intended to be a "maximum-development" scenario; however, it is biased towards the higher end of expected development and shows where the potential development might occur. If future development eventually exceeds RFD predictions, then the BLM and FS will assess the impacts to the resources under the context of the analysis provided in the PEIS or specific land use plans and determine if additional analysis is warranted.

The RFD was based on a review of recent government and industry reports providing assessments of geothermal potential across the western US (Western Governors' Association 2006; DOE and BLM 2003; NREL 2006; BLM 2007a; Geothermal Energy Association 2007a) and the typical impacts associated with geothermal development (GeothermEx 2007). Few quantitative evaluations have been conducted at this scale, and those that exist are considered largely speculative due to the wide array of variables around future geothermal development. These variables include the speculative estimation of unexplored geothermal resources, the development of geothermal technologies that may allow for extraction of resources currently unusable, the unknown nature of future energy markets, and the unknown future of regulatory and political climates. While some reports cite substantial barriers to geothermal development, current movements in energy markets as well as political and regulatory climates look favorable for an expansion of geothermal energy development to move forward.

The BLM and FS have updated the RFD in this PEIS in response to public and agency comments and upon further reflection regarding recent developments that support the potential for some commercial electrical generation in Montana and Wyoming.

2.5.1 RFDs for Electrical Generation (Indirect Use)

Nearly 50 percent of the nation's geothermal energy production occurs on Federal land, largely in California and Nevada. The BLM manages 57 producing geothermal leases that provide geothermal energy to 54 power plants, with a capacity of 1,275 megawatts and produced about 4,609 gigawatt hours of electricity during fiscal year 2007.

Projected Power Plant Development

It is estimated that the 12 states in the project area have 5,540 MW of geothermal potential considered viable for commercial development by 2015, with a further 6,660 to 6,670 MW being forecast by 2025. This capacity is expected to be realized through approximately 111 additional power plants by 2015, and a further 133 power plants by 2025. Using these values, it is estimated that the average viable capacity at any particular site is 50 MW by 2025 (Western Governors' Association 2006). This projection is in addition to existing and plan capacity for the given locations.

Location of Development

Development would be distributed across the area shown by the geothermal potential map, developed as part of this PEIS (see Figures 1-5 and 1-6). The greatest development is expected to occur in California and Nevada, and the least in Arizona, Colorado, Wyoming, and Montana. A state-by-state breakdown of the potential is provided in Table 2-6, listing the states in order of decreasing capacity and decreasing expected intensity of development.

State-by-state potentials are further broken down into specific areas in Table 2-7, along with the likely development capacities for those areas. The table also includes the BLM Field Offices and National Forests associated with the high potential areas. These potential development sites are based on current best available information. Heat flow maps and existing hot spring location maps do not show a consistent area of high potential in Montana and Wyoming; therefore, no location-specific development expectations have been included in

Table 2-6
Estimated Future Geothermal Electrical Generation Development by State

State	Estimated Commercial Development by 2015 (MW)	Estimated Commercial Development by 2025 (MW)
California	2375	4703
Nevada	1473	2880
Idaho	855	1670
Oregon	380	1250
Utah	230	620
Washington	50	600
New Mexico	80	170
Alaska	20	150
Arizona	20	50
Colorado	20	50
Montana*	20	50
Wyoming*	20	50

Source: Western Governors' Association 2006; BLM and DOE 2003.
* Commercial development was not anticipated for Montana or Wyoming by the Western Governor's Task Force; however, based on input during the review of the Draft PEIS and recent developments in the two states, there is evidence that there is commercial generation potential.

Table 2-7
Commercially Viable Geothermal Capacity for Electrical Generation by High Potential Area and Associated BLM Field Offices and National Forests

State	Area of Potential	Projected MW at 2015	Projected MW at 2025	Associated BLM FO	Associated National Forest
CA	Border	0	30	El Centro	none
CA	Brawley	200	463	El Centro	none
CA	Calistoga	10	20	Ukiah	none
CA	Clear Lake Volcanic Field area	20	50	Ukiah	none
CA	Coso area	75	150	Ridgecrest	none
CA	Dunes	0	10	El Centro	none
CA	East Mesa	50	100	El Centro	none
CA	Glamis	0	10	El Centro	none
CA	Heber	20	50	El Centro	none
CA	Honey Lake & Wendell & Amidy	10	10	Eagle Lake	none
CA	Kelly HS	0	10	Alturas	none
CA	Mono - Long Valley	120	240	Bishop	Inyo
CA	Medicine Lake / Glass Mountain	480	480	Alturas	Modoc

Table 2-7
Commercially Viable Geothermal Capacity for Electrical Generation by High Potential Area and Associated BLM Field Offices and National Forests

State	Area of Potential	Projected MW at 2015	Projected MW at 2025	Associated BLM FO	Associated National Forest
CA	Morgan Springs-Growler Springs (includes parts of Lassen not in the National Park)	0	50	Redding	Lassen
CA	Mount Signal	25	25	El Centro	none
CA	Niland	75	150	El Centro	none
CA	Randsburg area	10	40	Ridgecrest	none
CA	Salton Sea area	860	2000	El Centro	none
CA	Superstition Mountain	25	25	El Centro	none
CA	Surprise Valley/Lake City	25	50	Surprise	none
CA	The Geysers	150	300	Ukiah	Mendocino
CA	Westmorland	50	100	El Centro	none
CA	Truckhaven	25	50	El Centro	none
CA	Mount Shasta - Military Pass Road area	120	240	Redding	Shasta
CA	East Brawley	25	50	El Centro	none
NV	Aurora	120	240	Carson City	Toiyabe
NV	Baltazor Hot Springs	15	30	Winnemucca	none
NV	Beowawe Hot Springs	50	100	Elko	none
NV	Blue Mountains	30	90	Winnemucca	none
NV	Brady Hot Springs	10	20	Winnemucca	none
NV	Buffalo Valley, Big Smoky Valley, Smith Creek Valley, and Monitor Valley	100	200	Battle Mountain	none
NV	Colado	30	60	Winnemucca	none
NV	Crescent Valley	50	100	Battle Mountain	none
NV	Desert Peak area	20	50	Winnemucca	none
NV	Dixie Valley	70	70	Carson City	none
NV	Sulfur Hot Springs (Double - Black Rock)	0	50	Elko	Humboldt
NV	Emigrant	50	100	Elko	none
NV	Fallon / Carson Lake	50	150	Carson City	none
NV	Fish Lake Valley	50	75	Battle Mountain	none
NV	Fly Range (Granite Ranch)	10	20	Winnemucca	none
NV	Great Boiling Springs (Gerlach)	30	60	Winnemucca	none
NV	Hawthorne	20	40	Carson City	none
NV	Hazen (Black Butte)	10	20	Carson City	none
NV	Hot Sulphur Springs (Tuscarora)	20	40	Elko	none

Table 2-7
Commercially Viable Geothermal Capacity for Electrical Generation by High Potential Area and Associated BLM Field Offices and National Forests

State	Area of Potential	Projected MW at 2015	Projected MW at 2025	Associated BLM FO	Associated National Forest
NV	Hyder Hot Springs	10	20	Winnemucca	none
NV	Kyle Hot Springs	15	30	Winnemucca	none
NV	Kyle Hot Springs (Granite Mtn.)	15	30	Winnemucca	none
NV	Leach Hot Springs	18	36	Winnemucca	none
NV	Lee & Allan Hot Springs	30	60	Carson City	none
NV	McGee Mountain	10	20	Winnemucca/ Surprise	none
NV	New York Canyon	35	70	Winnemucca	none
NV	North Valley / Black Warrior Peak	37	49	Winnemucca	none
NV	Pinto Hot Springs	29	58	Winnemucca	none
NV	Pirouette Mountain	23	46	Carson City	none
NV	Pumpernickel Valley	30	60	Winnemucca	none
NV	Pyramid Lake Indian Reserve	25	50	Carson City	none
NV	Rye Patch (Humboldt House District)	15	30	Winnemucca	none
NV	Salt Wells	50	50	Carson City	none
NV	San Emidio Desert area (Empire)	13	20	Winnemucca	none
NV	Shoshone-Reese River	18	36	Battle Mountain	none
NV	Silver Peak	50	100	Battle Mountain	none
NV	Soda Lake area	20	35	Carson City	none
NV	South Hot Springs	10	20	Carson City	Toiyabe
NV	Steamboat Springs	50	100	Elko	Toiyabe
NV	Stillwater area	30	60	Elko	Humboldt
NV	Trinity Mountains	50	75	Carson City	none
NV	Wabuska	10	20	Carson City	none
NV	Wilson Hot Springs	10	20	Carson City	Toiyabe
NV	Other non-geographically named locations.	150	300	Battle Mountain, Carson City, Elko, Winnemucca	Toiyabe
ID	Crane Creek - Cove Creek area	25	50	Four Rivers	none
ID	Raft River	150	200	Burley	none
ID	Big Creek Hot Springs	10	20	Salmon	Salmon-Challis
ID	Rexburg	20	100	Upper Snake	none
ID	Willow Springs	100	200	Upper Snake	none
ID	China Cap	100	200	Pocatello	none

Table 2-7
Commercially Viable Geothermal Capacity for Electrical Generation by High Potential Area and Associated BLM Field Offices and National Forests

State	Area of Potential	Projected MW at 2015	Projected MW at 2025	Associated BLM FO	Associated National Forest
ID	Other potential locations	450	900	Four Rivers, Burley, Jarbidge, Shoshone	
OR	Newberry Caldera	240	480	Prineville	Deschutes
OR	Crump's Hot Springs	20	40	Lakeview	none
OR	Three Creeks Butte	20	40	Prineville	Deschutes
OR	Trout Creek area	10	20	Prineville	Deschutes
OR	Neal Hot Springs	25	50	Vale	none
OR	Lakeview ~ Hot Lake area	20	20	Lakeview	none
OR	Summer Lake	20	50	Lakeview	Fremont
OR	Three Sisters, Mt Rose (east), Mt Hood	25	500	Prineville	Ochoco, Deschutes, Mt Hood
OR	Other potential locations	0	50	Burns, Vale, Prineville	none
UT	Cove Fort-Sulphurdale	50	200	Fillmore	Fishlake
UT	Roosevelt Hot Springs	100	250	Cedar City	none
UT	Thermo Hot Springs	50	100	Cedar City	none
UT	New Castle	10	20	Cedar City	none
UT	Other (Monroe, Mineral Mountain, etc.)	20	50	Richfield	Fishlake
WA	Mt Baker	50	100	Wenatchee	Mt. Baker-Snoqualmie
WA	Other Cascade volcanoes (Mt Adam area, Wind River area)		500	Wenatchee	Gifford Pinchot, Mt. Baker-Snoqualmie, Okanogan-Wenatchee
NM	Lower Rio Grande Rift (Including Tortugas Mtn. & Rincon)	50	100	Las Cruces	Gila (Lower Rio Grande Rift)
NM	Lightning Dock	20	40	Las Cruces	none
NM	Radium Springs, McGregor, San Diego, Lower Frisco	10	30	Las Cruces	none
AK	Hot Springs Bay Valley, Bell Island Hot Springs, Circle Hot Springs, Unalaska	20	150	Anchorage and Eastern Interior	Tongass (Bell Is. only)

Table 2-7
Commercially Viable Geothermal Capacity for Electrical Generation by High Potential Area and Associated BLM Field Offices and National Forests

State	Area of Potential	Projected MW at 2015	Projected MW at 2025	Associated BLM FO	Associated National Forest
AZ	Clifton, Gillard	20	50	Safford	Apache/ Sitgraves National Forest
CO	Waunita, Routt, Cottonwood, Mt Princeton, Poncha and Pagosa Hot Springs. Wagon Wheel Gap, Orvis, Ouray.	20	50		Routt (Routt), Uncompahgre (Orvis, Ouray), Rio Grande (Wagon Wheel Gap), San Juan (Poncha), Gunnison (Pagosa, Waunita), Arapaho/Gunnison (Cottonwood, Mt. Princeton)

Source: Western Governors' Association 2006; BLM and DOE 2003.

Table 2-7 for these two states. Additional locations unknown or unexpected at this time may occur. Development at any site will require additional NEPA evaluation to address site-specific resource values and analyze potential impacts.

Typical Phases in Geothermal Development

This RFD for geothermal resource use involves four sequential phases: (1) exploration, (2) drilling, (3) utilization, and (4) reclamation and abandonment. The success or failure of each phase affects the implementation of subsequent phases, and, therefore, subsequent environmental impacts. Development of geothermal resources is unique to the industry, but many activities are similar in scope to other fluid minerals (e.g., oil and gas), such as surveying, drilling, site-development (well pads and roads), and reclamation and abandonment. The general assumptions outlined in the following four phases serve to establish RFD scenarios for analyzing future environmental impacts that may result from development following BLM issuance of leases for geothermal resources within the identified area of geothermal potential. It should be noted that the RFD scenario permits a general evaluation of the types of impacts that may occur but cannot accurately predict the magnitude and extent of these impacts. This is due in part to the uncertainty about the timing, location, distribution of the geothermal resources, and the likely types of development.

Table 2-8 provides the estimated acreages of land disturbance for each phase in geothermal development for a typical power plant. The actual area of disturbance varies greatly depending upon site conditions and the type and size of power plant being constructed; therefore, a range is provided. Acreages are not provided for the Reclamation and Abandonment phase since this phase involves the return of previously disturbed lands to their existing conditions. The total potential amount of area disturbed under the utilization phase includes development activities. Much of the land would be reclaimed after the initial exploration, drilling, and construction; therefore, the actual amount of land occupied during operation, would be less. A typical development generally requires several leases or the use of private or other adjacent lands. The details of each phase of development are described below.

Table 2-8
Typical Disturbances by Phase of Geothermal Resource Development

Development Phase	Disturbance Estimate per Plant
Exploration	**2 – 7 acres**
Geologic mapping	negligible
Geophysical surveys	30 square feet[1]
Gravity and magnetic surveys	negligible
Seismic surveys	negligible
Resistivity surveys	negligible
Shallow temperature measurements	negligible
Road/access construction	1- 6 acres
Temperature gradient wells	1 acre[2]
Drilling Operations and Utilization	**51 – 350 acres**
Drilling and well field development	5 – 50 acres[3]
Road improvement/construction	4 – 32 acres[4]
Powerplant construction	15 – 25 acres[5]
Installing wellfield equipment including pipelines	5 – 20[6]
Installing transmission lines	24 – 240[7]
Well workovers, repairs and maintenance	Negligible[8]
TOTAL	**53 – 367 acres**

[1] Calculated assuming 10 soil gas samples, at a disturbance of less than three square feet each.
[2] Calculated assuming area of disturbance of 0.05 to 0.25 acre per well and six wells. Estimate is a representative average disturbance of all well sites. Some wells may require a small footprint (e.g., 30x30 feet), while others may require larger rigs and pads (e.g., 150x150 feet).
[3] Size of the well pad varies greatly based on the site-specific conditions. Based on a literature review, well pads range from 0.7 acres up to 5 acres (GeothermEx 2007; FS 2005). Generally a 30MW to 50 MW power plant requires about five to 10 well pads to support 10 to 25 production wells and five to 10 injection wells. Multiple wells may be located on a single well pad.
[4] One-half mile to nine miles; assumes about ¼ mile of road per well. Estimates 30-foot wide surface disturbance for a 18-20 foot road surface, including cut and fill slopes and ditches.
[5] 30 MW plant disturbs approximately 15 acres; 50 MW plant disturbs approximately 25 acres.
[6] Pipelines between well pad to plant assumed to be ¼ or less; for a total of 1½ to seven miles of pipeline in length, with a 25-foot-wide corridor
[7] Five to 50 miles long, 40-foot-wide corridor.
[8] Disturbance would be limited to previously disturbed areas around the well(s).

Phase One: Geothermal Resource Exploration

Before geothermal resources are developed, a geothermal resource developer explores for evidence of geothermal resources on leased or unleased land. Exploration includes ground disturbance but does not include the direct testing of geothermal resources or the production or utilization of geothermal resources. Exploration operations include, but are not limited to, geophysical operations, drilling temperature gradient wells, drilling holes used for explosive charges for seismic exploration, core drilling or any other drilling method, provided the well does not reach the geothermal resource. It also includes related construction of roads and trails, and cross-country transit by vehicles over public land. Exploration involves first surveying and then drilling temperature gradient wells. It generally takes between one and five years to complete exploration.

Surveying includes conducting or analyzing satellite imagery and aerial photography, volcanological studies, geologic and structural mapping, geochemical surveys, and geophysical surveys of leasable areas that could support geothermal resource development. The surveys consist of collecting electrical, magnetic, chemical, seismic, and rock data. For example, water samples from hot springs could be used to determine the subsurface characteristics of a particular area. Once the data is compiled, geologists and engineers examine the data and make inferences about where the higher temperature gradients may occur. High temperature gradients can indicate the location of potential underground geothermal reservoirs capable of supporting commercial uses.

Surveys may require creating access using four-wheel drive vehicles, or by helicopters or on foot to areas with no roads or very poor roads. Cutting of vegetation may be required in some areas to facilitate access. In some cases, gas collectors may be installed to measure soil gases. These collectors have partially buried sensors and may disturb small areas of less than three square feet (BLM 2007b).

While not widely used for geothermal surveys, seismic surveys have the greatest survey impact on the local environment. These surveys typically involve setting up an array of geophones and creating a pulse or series of pulses of seismic energy. The pulse is created either by detonating a small charge below the ground surface (requires drilling a narrow "shot hole") or by a vibroseis truck that is driven through the survey area. Data is transmitted from the geophones to a central location. The geophones may be installed on the ground's surface, in small excavations made specifically for burying the geophones, and/or in existing wells. These surveys are typically undertaken over the course of a few days. In areas where there is a lot of natural seismic activity, longer term installation of geophones may be undertaken to record naturally occurring earthquakes. Such cases do not involve a vibroseis truck (BLM 2007b).

Resistivity surveys include various methodologies from laying out long cables (up to 1,000 feet or more) on the land surface, or setting up equipment repeatedly in small areas (a few tens of square feet at the most for each measuring site). Minor, temporary disturbances are associated with each site for the burial of sensors (BLM 2007b).

The second step of the exploration phase is to drill temperature gradient wells on leased or unleased land. This process confirms a more precise location of high temperature gradients. Temperature gradient wells can be drilled using a truck-mounted rig and range from 200 feet to over 4,000 feet deep. The number of gradient wells also varies, depending on the geometry of the system being investigated and the anticipated size of power development. Geologists examine either rock fragments or long cores of rock that are brought up from deep within the well. Water samples are taken from any groundwater encountered during drilling. Also, temperatures are measured at depth. Both well temperatures and the results of rock sample analyses are used to determine if additional exploration is necessary to identify the presence and characteristics of an underground geothermal reservoir. After collecting the desired materials and data, the wells are completed with sealed, water-filled tubing from surface to bottom, often with cement around the tubing (BLM 2007b).

Source: Geothermal Education Office

Truck Mounted Rotary Rigs are commonly used to drill temperature gradient wells.

Most temperature gradient wells are drilled with a small rotary rig (often truck-mounted) similar to that used for drilling water wells, or a diamond-coring rig, similar to that used for geologic sampling in mineral exploration and civic works projects. Neither rig of this size requires construction of a well pad or earth moving equipment unless the site is sharply graded. Support equipment is needed, including water trucks, tanks for mixing and holding drilling fluids, personnel and supply transport vehicles, and sometimes a backhoe for earth-moving activities is needed to prepare the drilling site. A temperature gradient drilling operation can be run by about three on-site personnel and others traveling to the site periodically with materials and supplies (BLM 2007b).

Temperature-gradient well drilling requires road access. Whenever possible, a driller would access the temperature gradient well site using existing roads. When existing roads are not available, new access roads may need to be constructed for the truck-mounted rig to reach the site; this could require one to six acres of disturbance.

Preparing the site for drilling could include leveling the surface and clearing away vegetation. Several temperature gradient wells are usually drilled to determine both the areal extent of the temperature anomaly and where the highest temperature gradient occurs. Each drill site could disturb approximately 0.10 acres, and the drill rig could be approximately 60 feet tall. During exploration, a driller is not permitted to produce any fluids out of, or inject any fluids into, the well; therefore, the site may also host a sump or tanker truck. Additionally, a diesel generator may also be used at the site to power equipment. The well site itself involves excavation of a small cellar (typically less than three feet square and less than three feet deep) to allow the conductor casing to be set beneath the rig. Drilling may last for several weeks.

Temperature gradient wells are not intended to directly contact the geothermal reservoir, and therefore produce no geothermal fluids. In areas of known artesian pressures, any drilling expected to penetrate the groundwater table would include blow-out prevention equipment. In cases where a temperature gradient well does penetrate a geothermal zone, any release of geothermal fluids at the surface is likely to be minimal due to the small well diameters and the use of blow-out prevention equipment (BLM 2007b).

Drilling fluids may include drilling mud (bentonite clay, activated montmorillonite clay and crystalline silica-quartz), drilling mud additives (caustic soda, sodium bicarbonate, and anionic polyacrylamide liquid polymer), cement (Portland cement and calcium chloride), fuel (diesel), lubricants (usually petroleum-based) and coolants. The specific fluids and additives depends on a variety of factors, including the geologic formations being penetrated and the depth of the well. Releases of drilling muds are not permitted; a sump and tanker truck are required to capture all fluids. The risk of spills of other fluids is similar to that of any other project involving the use of vehicles and motorized equipment (BLM 2007b).

All surface disturbances would be reclaimed to the satisfaction of BLM and FS. If a temperature gradient well was unsuccessful, it would be abandoned, and the drill site would be reclaimed. Abandonment includes plugging, capping, and covering the wells. Reclamation includes removing all surface equipment and structures, regrading the site to predisturbance contours, and replanting native or appropriate vegetation to facilitate natural restoration.

Phase Two: Drilling Operations

Once exploration has confirmed a viable prospect for commercial development and necessary leases have been secured, the drilling of exploration wells to test the reservoir can proceed. Drilling Operations include flow testing, producing geothermal fluids for chemical evaluation or injecting fluids into a geothermal reservoir. This would also involve the construction of sumps or pits to hold excess geothermal fluids. It could involve development of minor infrastructure to conduct such operations.


Source: Geothermal Education Office

Drilling is an intensive process that requires the use of large production drill rigs

Drilling is an intense activity that requires large equipment (e.g., drill rig) and can take place 24 hours a day. A drilling operation generally has from 10 to 15 people on-site at all times, with more people coming and going periodically with equipment and supplies. Getting the rig and ancillary equipment to the site may require 15 to 20 trips by full-sized tractor-trailers; with a similar amount for de-mobilizing the rig. There would be 10 to 40 daily trips for commuting and hauling in equipment (BLM 2007b).

If a reservoir is discovered, characteristics of the well and the reservoir are determined by flow testing the well. If the well and reservoir were sufficient for development, a wellhead, with valves and control equipment, would be installed on top of the well casing. Excess geothermal fluids are stored in temporary pits or sumps, generally lined with plastic (small sumps) or clay (large sumps). The water is left to evaporate and any sludge is removed and properly disposed.

Phase Three: Utilization

Utilization and production is the next phase after a viable reservoir is determined and includes the infrastructure needed for commercial operations, including access roads, construction of facility structures, building electrical generation facilities, drilling and developing well fields, and installing pipelines, meters, substations, and transmission lines. The utilization phase could last from 10 to 50 years and involves the operation and maintenance of the geothermal field(s) and generation of electricity.

The type of development utilization that occurs is based on the size and temperature of the geothermal reservoir. Geothermal resources can be classified as low temperature (less than 90°C, or 194°F), moderate temperature (90°C to 150°C, or 194 to 302°F), and high temperature (greater than 150°C, or 302°F). Only the highest temperature resources are generally used for generating electrical power; however, with emerging technologies and in colder climates such as Alaska, even the lower temperature resources are proving usable for electrical generation.

High temperature reservoirs are suitable for the commercial production of electricity. Three types of power plants that harness geothermal resources are dry steam plants, flash steam plants, and binary-cycle plants. Occasionally a hybrid between flashed steam and binary system is also used. Dry steam power plants use the steam from the geothermal reservoir as it comes from the wells and route it directly through turbine/generator units to produce electricity. Flash steam power plants use water at temperatures greater than 182°C (360°F). Water is pumped under high pressure to the generation equipment at the surface, the pressure is suddenly reduced, allowing some of the hot water to convert, or "flash," into steam, and the steam is used to power the turbine/generator units to produce electricity. Binary-cycle power plants use water from the geothermal reservoir to heat another "working fluid." The working fluid is vaporized and used to turn the turbine/generator units. The geothermal water and the working fluid never come in contact with each other. Binary-cycle power plants can operate with lower water temperature 74°C to 182° C (165°F to 360°F) and produce few air emissions. See Chapter 1 for a more detailed discussion.

Development of the lease would involve the following construction and operations:

- Access roads—New access roads to accommodate the larger equipment associated with the development phase could be constructed. In general, a plant can require 1/2 –mile to nine miles of roads in order to access the site, well pads, and power plant. Depending on the type and use-intensity of the road, the areas of surface disturbance is about 30-feet wide for a 18-20 foot wide road surface, including cut and fill slopes and ditches.
- Drill site development— Multiple wells may be drilled per lease. Production-size wells can be over two miles (10,560 feet) deep. The number of wells is dependent upon the geothermal reservoir characteristics and the planned power generation capacity. For example, a 50MW (net) power plant could require up to 25 production wells and 10 injection wells. It is common that multiple wells would be installed on a well pad. The size of the well pad is dependent upon site conditions and on the number of wells for the pad, but they are typically about one to five acres, including minor cut and fill. In order to drill these deep holes, a large drilling rig or derrick would be erected. Various temporary support facilities may be located on-site, including generators, mud tanks, cement tanks, trailers for the drillers and mud loggers, housing trailers, and storage sheds. As appropriate, facilities can be painted to blend in with the surrounding environment. Drilling operations can occur 24 hour a day.
- Wellfield equipment—A geothermal power plant is typically supported by pipeline systems in the plant's vicinity. The pipeline systems include a gathering system for produced geothermal fluids, and an injection system for the reinjection of geothermal fluids after heat extraction takes place at the plant. Pipelines are usually 24 to 36 inches in diameter, but can be

Source: Geothermal Education Office

A well head and pipeline are part of the overall well field that connects the resource to the power plant


Source: Geothermal Education Office

Pipelines connect the wells to the power plant.

as small as 8 inches depending on the type of pipeline. Pipelines transporting hot fluids or steam to the plant are covered with insulation, whereas injection pipelines are generally not. When feasible, they would parallel the access roads and existing roads to the destination of the geothermal resource's steam or water. Pipelines are typically constructed on supports above ground, resulting in little if any impact to the surrounding area once construction is complete and the corridor has been revegetated. The pipelines typically have a few feet of clearance underneath them, allowing small animals to easily cross their path. The pipelines are typically painted to blend in with the surrounding environment. In general, plants have about 1½ to seven miles of pipes with a corridor width of about 25 feet.


Power plants include a variety of infrastructure, including cooling towers.

- Power plant—A 50 MW plant would utilize a site area of up to 20 to 25 acres to accommodate all the needed equipment, including the power plant itself, space for pipelines geothermal fluids and reinjection, a switch yard, space for moving and storing equipment, and buildings needed for various purposes (power plant control, fire control, maintenance shop, etc.). The power plant itself would occupy an estimated 25 percent of this area for a water-cooled plant, or about 50 percent for an air-cooled plant. Where topography permits, the power plant could be situated so as to be less visible from nearby roads, trails, scenic vistas or scenic highways. The site of the plant requires reasonable air circulation to allow for efficient operation of the plant's condensers. A smaller, 20 MW plant would typically require approximately five to ten acres for the entire complex.


Transmission lines are critical for getting the power from the resource to the consumer.

- Electric transmission lines—Transmission lines may range in length from 5 miles to 50 miles with a corridor width of approximately 40 feet. Wooden poles most likely support them, and about 5 acres could be disturbed per mile of transmission line.

- Reclamation—When a production well is successful, a wellhead with valves and control equipment is installed on top of the well casing. If a production well is unsuccessful, the production well would be plugged and capped, and the site would be reclaimed.

The number of personnel required during construction varies significantly, but at any one point there may be a few hundred laborers and professionals on-site with attendant vehicle traffic. The number of people required for routine operation of a power plant is typically three per shift; however, additional personnel (as many as 12 total, depending on plant size) may be on site during the day for maintenance and management (BLM 2007b)

Activities associated with operation and maintenance and energy production would involve managing waste generated by daily activities, managing geothermal water, landscaping, and the maneuvering of construction and maintenance equipment and vehicles associated with these activities.

Phase Four: Reclamation and Abandonment

This phase involves abandoning the well after production ceases and reclaiming all disturbed areas in conformance with BLM and FS standards. Abandonment includes plugging, capping, and reclaiming the well site. Reclamation includes removing the power plant and all surface equipment and structures, regrading the site and access roads to predisturbance contours, and replanting native or appropriate vegetation to facilitate natural restoration.

Areas of Disturbance from Power Plant Development

The phase of development resulting in the greatest area of disturbance is the geothermal resource development stage, which includes the expansion of well pads and access roads, drilling of the production and reinjection wells, construction of the power plants, pipelines, and electrical transmission lines. Projected ranges for areas of disturbance from each of these components on both a per-plant basis (Table 2-8) and cumulatively across the entire planning area for both 2015 and 2025 are shown in Table 2-9.

Table 2-9
Cumulative Range of Acre Disturbances for the RFD

Component	Total Acreage Range per 50MW Plant[1]	Projected 2015 Acreage Range Across Planning Area[2]	Projected 2025 Acreage Range Across Planning Area[2]
Access roads	4 – 32	444 – 3,552	976 – 7,808
Well pads	5 – 50	555 – 5,550	1,220 – 12,200
Pipelines	5 – 20	555 – 2,220	1,220 – 4,880
Power plants	15 – 25	1,665 – 2,775	3,660 – 6,100
Electrical transmission lines	24 – 240	2,664 – 26,640	5,856 – 58,560
TOTAL	**53 – 367**	**5,883 – 40,737**	**12,932 – 89,548**

[1] See assumptions in Table 2-8.
[2] Calculated assuming 111 power plants at 50 MW each by 2015, and a further 133 power plants of 50 MW each by 2025.

Geothermal Fluid Production and Associated Waste

Geothermal fluid production and associated waste production is likely to occur for short periods as wells are tested to determine reservoir characteristics. If geothermal fluids are discovered in commercial quantities, development of the geothermal field is likely. The rate of fluid production from a geothermal reservoir is unknown until the development testing phase is completed. During the initial stages of testing, one well is likely to be tested at a time. If testing is successful and the well and reservoir are sufficient for development, wellheads, valves, and control equipment would be installed on top of the well casing.

Using data from other areas of geothermal development, it appears that production of geothermal fluids can be expected to vary widely from one to six million gallons per well, per day. Assuming five million gallons per day, per well as an average production figure, a lease with two producing wells would produce 10 million gallons of fluid per day.

Most geothermal fluids produced are re-injected back into the geothermal reservoir, via reinjection wells. In flash steam facilities about 15-20 percent of the fluid can be lost due to flashing to steam and evaporation through cooling towers and ponds. Binary power plants utilize a closed loop system, therefore, well production and reinjected operate with no fluid loss. Fluids can also be lost due to pipeline failures or surface discharge for monitoring/testing the geothermal reservoir.

The routinely used chemicals for a binary geothermal plant include the hydrocarbon working fluid (such as iso-butane or n-pentane) and the lubricating oil used in the downhole pumps. If a well's pressure falls below the "bubble point," if it possible that downhole scaling might occur. This requires either a mechanical clean-out with a drilling rig or a coiled-tubing unit, or an "acid job," during which acid (typically hydrochloric acid or less commonly hydrogen fluoride) is injected into the wellbore to dissolve the scale. If scaling is persistent, the operator may choose to adopt routine injections of a scale-inhibitor chemical, such as polymaleic anhydride or polyacrylic acid, used in dosages of one to 10 parts per million (US BLM 207b).

2.5.2 RFDs for Direct Use

Geothermal waters are being used directly for a wide variety of applications across the western US. These uses include:

- Agricultural uses, such as controlling environmental conditions for growing crops, flowers, or trees;
- Aquacultural uses, such as controlling environmental conditions for raising fish or other animals;

- District heating and cooling systems for college campuses, residential neighborhoods, municipal buildings, national park buildings, and other types of buildings;
- Public safety uses, such as eliminating ice and snow on public sidewalks;
- Public health uses through food processing, such as dehydration, washing, and processing; and
- Recreational uses, such as hot tubs, steam baths, and mud baths.

Direct use applications are distributed across the project area, with the greatest number being in California, Idaho, Oregon and Colorado. Table 2-10 lists the six major categories of direct use applications, and the prevalence of each within the 12 states covered by this PEIS. The size of these applications range from less than 0.1 to 30 thermal megawatts, with most being between one and six thermal megawatts.

Table 2-10
Distribution of Direct Use Applications within Project Area

Direct Use Application	AK	AZ	CA	CO	ID	MT	NM	NV	OR	UT	WA	WY
Greenhouses	4	0	4	1	13	4	4	0	4	5	0	1
Aquaculture	0	4	17	4	5	1	0	5	2	1	0	1
Spas/pools	10	6	57	18	36	19	12	13	18	11	6	16
Space heating	7	1	18	15	9	10	1	6	22	2	0	1
District heating	0	0	3	1	5	0	2	4	2	0	0	0
Industrial	0	0	1	0	0	1	0	0	1	0	0	0

Source: Oregon Institute of Technology 2008

Projected Applications Development

Quantitative estimates of the thermal energy of likely-to-be-developed direct use applications over the 2015 to 2025 timeframe are not available for the western US in the way that they are for indirect uses; however, for the US as a whole, the DOE National Renewable Energy Laboratory has developed estimates of thermal megawatts that are developable. It is estimated that by 2015, direct use applications could be developed in the amount of 1,600 thermal megawatts, and by 2025, this number is estimated to be 4,200 thermal megawatts (NREL 2006).

The cost in exploration of geothermal resources for direct use is a limiting factor in many direct use proposals. Drilling exploration wells is cost-intensive and there is no guarantee of finding a sufficient resource on first attempt. Unlike most geothermal electric power projects that are funded by corporations who can handle both the risk and substantial costs of exploration activities, most direct use projects are implemented by smaller companies or individual entrepreneurs or communities that have less financing and smaller projected profits.

Advances in exploratory technology and methodology as well as new grant programs to help project proponents get exploration underway could result in an acceleration of development of direct use applications across the western US.

Location of Development

Direct uses do not require the same high-temperature waters that are required for electricity generation; therefore, the geographic areas considered to have potential for direct use applications are much broader than the areas considered having potential for indirect use. The potential areas of development of direct use applications are indicated by the bounds of the geothermal potential map, developed as part of this PEIS (see Figures 1-5 and 1-6).

Direct use resources are more likely to be developed when they are in proximity to existing communities. In the 12 state project area, it is estimated that there are 293 "collocated" cities and communities with a combined population of 7.4 million that could potentially utilize geothermal heat through direct uses. The collocated communities counted here are defined as being within five miles of a known geothermal resource having a temperature of at least 122°F (50°C) (Oregon Institute of Technology 2008).

Typical Phases in Development

Phase One: Exploration

Existing direct use applications are largely collocated with, and draw directly from, existing surface geothermal manifestations such as hot springs, eliminating the need for most exploration activities. Exploration activities in the past have often been limited to water temperature and chemistry analysis.

Looking to the future, it is likely that most direct use applications will not be able to draw from existing surface manifestations as they have in the past. Surface manifestations such as naturally occurring hot springs have become increasingly sought after with increases in population in the western US, increased recreational use, and more stringent regulations preserving such resources for their recreational, cultural or scenic value. In such cases where surface manifestations are not nearby or are not being utilized directly, exploration activities similar to those described above for indirect use would also apply for direct use.

Phase Two: Drilling
In applications where a surface manifestation is used directly, the resource development phase involves installing piping into that manifestation to withdraw the hot water. For applications requiring the drilling of a well, drilling activities would be the same as described above under Phase Two for indirect use.

Phase Three: Utilization
The utilization phase typically lasts for several decades or longer. Activities associated with the production phase are generally limited to maintenance and repair activities of all components of the collection, distribution and injection/use/disposal system.

As described above for indirect use, the drilling of production wells may be necessary. Drilling activities would be similar to that discussed above in the drilling phase. Some applications may inject the post-use geothermal fluids back into the ground, in which case an injection well would be drilled and connected via piping to the application. In other applications where the spent geothermal fluids are discharged to a surface water body or used for some other purpose, then discharge piping, collection systems or distribution systems may need to be constructed. For such systems where the waters are not reinjected into the geothermal reservoir but are rather discharged or otherwise used, treatment systems may need to be installed to reduce levels of any naturally occurring but toxic chemicals present within the geothermal waters, such as mercury, arsenic and boron to meet applicable health or environmental standards.

Operation and maintenance of existing facilities and production of geothermal energy also takes place during the production phase. Activities associated with operation and maintenance and energy production would involve managing waste generated by daily activities, managing geothermal water, landscaping, and the maneuvering of construction and maintenance equipment and vehicles associated with these activities.

Phase Four: Reclamation and Abandonment
As described above for indirect use, this phase involves abandoning the well after production ceases and reclaiming all disturbed areas in conformance with BLM and FS standards. Abandonment includes plugging, capping, and reclaiming the wells. Reclamation includes removing all surface equipment and structures, regrading the site to predisturbance contours, and replanting native vegetation.

Areas of Disturbance from Direct Use Applications
Surface disturbances for direct use are generally much less than for indirect use since direct uses are more likely to be located near existing communities with less of a need for new access roads. Also, since direct use applications utilize the geothermal energy on-site, there is no need for the construction of electrical equipment and transmission lines, except for bringing in electricity from the existing grid to the facility being constructed. Surface disturbances can still be

expected for well pad development, site access, and construction of the facility utilizing the resource, although in some cases the facility may already exist and may simply be shifting its heat source to geothermal.

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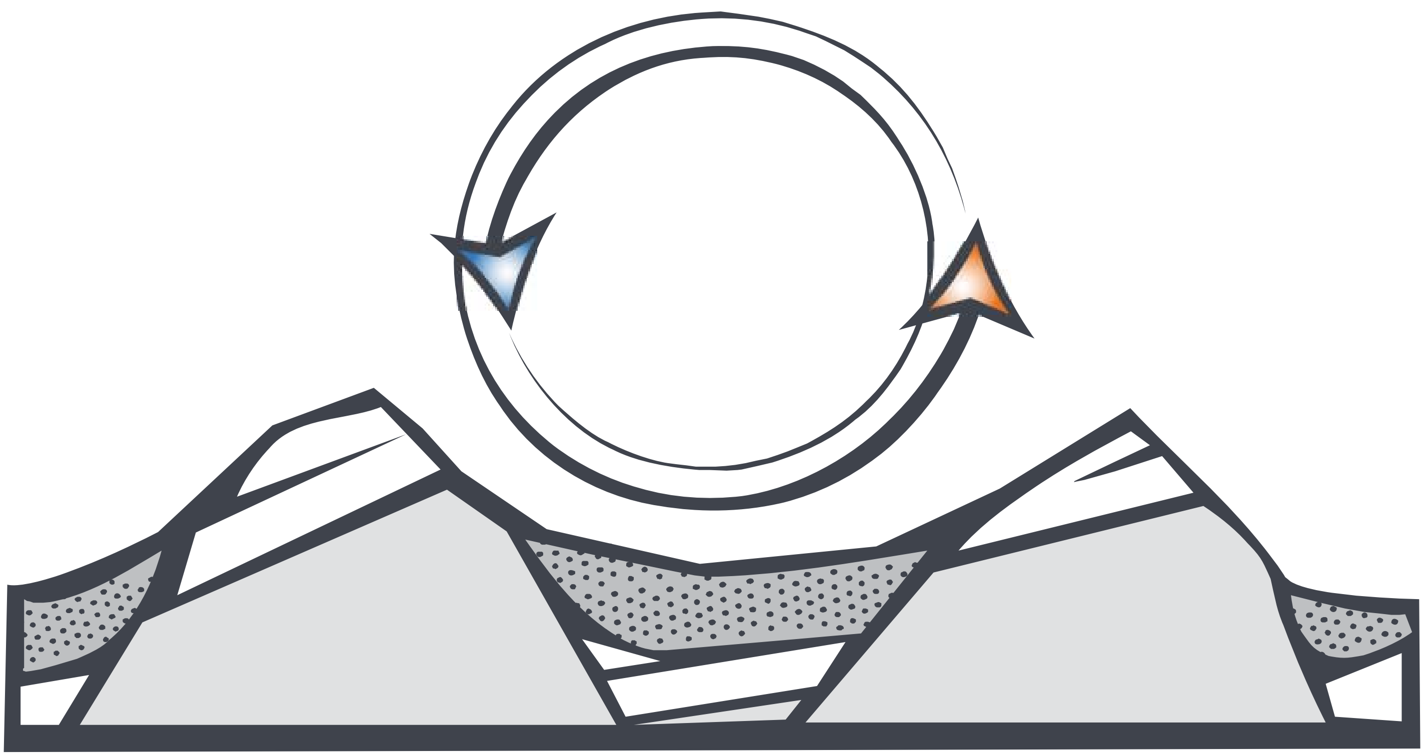

Chapter 3

Affected Environment

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CHAPTER 3
AFFECTED ENVIRONMENT

3.1 INTRODUCTION

This chapter provides a description of the biological, physical, and socioeconomic characteristics, including human uses, that could be affected by any future actions (including but not limited to any decisions to lease and/or develop geothermal resources) that may be taken consistent with implementing one of the alternatives considered in this PEIS, as described in Chapter 2. Information from broad-scale assessments were used to help set the context for the planning area. The information and direction for BLM resources has been further broken down into fine-scale assessments and information where possible. Specific aspects of each resource discussed in this section (e.g., water supply, air emissions, weeds, OHV use) were raised during the public and agency scoping process. The level of information presented in this chapter is commensurate with and sufficient to assess potential effects of any future actions (including but not limited to leasing and/or develop geothermal resources) that may be taken consistent with the alternatives in Chapter 4.

The planning area for the Geothermal PEIS is the area of geothermal potential in the western US states. The planning area includes BLM- and FS-administered surface lands with minerals under federal ownership that have geothermal potential and the subsurface federal geothermal mineral estate on other lands (see Section 1.9.1).

This section contains a description of the biological and physical resources of the planning area and follows the order of topics addressed as follows:

- Land Use, Recreation, and Special Designations;
- Geologic Resources and Seismic Setting;
- Energy and Minerals;
- Paleontological Resources;

- Soil Resources;
- Water Resources;
- Air Quality and Climate;
- Vegetation;
- Fish and Wildlife;
- Threatened and Endangered Species and Special Status Species;
- Wild Horse and Burros;
- Livestock Grazing;
- Cultural Resources;
- Tribal Interests and Traditional Cultural Resources;
- Natural Scenic and Historic Trails;
- Visual Resources;
- Socioeconomics and Environmental Justice;
- Health and Safety; and
- Noise
- Health and Safety

Table 3-1 lists identified critical resources and where they are addressed in this EIS.

Table 3-1
Critical Resources Identified Through Scoping

Resource	Corresponding PEIS Section
Air Quality	Air Quality and Climate
Areas of Critical Environmental Concern	Land Use, Recreation, and Special Designations
Cultural Resources	Cultural Resources and Tribal Interests and Traditional Cultural Resources
Hazardous Materials	Health and Safety
Invasive and Nonnative Species	Vegetation
Migratory Birds	Fish and Wildlife
Native American Religious Concerns	Tribal Interests and Traditional Cultural Resources
Threatened and Endangered Species	Threatened and Endangered Species and Special Status Species
Water Quality (Surface/Ground)	Water Resources
Wetlands/Riparian Zones	Vegetation
Wild and Scenic Rivers	Land Use, Recreation, and Special Designations
Wilderness	Land Use, Recreation, and Special Designations

3.2 LAND USE, SPECIAL DESIGNATIONS, AND RECREATION

3.2.1 Land Use

The western US is comprised of federally managed lands intermixed with private parcels. In some areas, federally managed lands dominate the landscape with small parcels of private lands (e.g., Nevada). However, in other instances, large tracts of private lands are interspersed with smaller tracts of federally managed lands (e.g., California). Federal lands are managed by federal agencies that have specific legislation guiding how their lands are to be used. The BLM and FS are two of the largest land management agencies mandated by national policies to administer their lands under the concept of multiple uses, while protecting long-term land health. Other federal land managers include the US Department of Defense, USNPS, USFWS, and US Bureau of Reclamation. Table 3-2, Acreage and Percentage of Federally Managed Lands in the Project Area as of Fiscal Year 2006, identifies the acreage of federal land within the project area (12 western states).

Table 3-2
Acreage and Percentage of Federally Managed Lands in the Project Area as of FY2006

State	Total State Acreage	Federal Land Acreage	Percent Land Federally Managed
Alaska	368,993,000	250,640,000	67.93
Arizona	72,777,000	51,084,000	70.19
California	100,977,000	52,879,000	52.37
Colorado	66,624,000	27,604,000	41.43
Idaho	53,339,000	36,413,000	68.27
Montana	94,234,000	37,940,000	40.26
Nevada	70,828,000	62,530,000	88.28
New Mexico	77,925,000	35,077,000	45.01
Oregon	62,126,000	34,840,000	56.08
Utah	54,318,000	39,018,000	71.83
Washington	43,064,000	16,825,000	39.07
Wyoming	62,593,000	31,633,000	50.54
Total	**1,127,798,000**	**676,483,000**	**59.98**

Source: BLM 2008c; FS 2008a

Federal Lands in the Planning Area

Within the planning area, or geothermal potential area, the BLM manages about 143 million acres and the FS manages about 104 million acres. These agencies are responsible for managing natural resources and resource uses, such as timber, minerals, livestock grazing, recreation, wildlife, and wilderness.

Table 3-3, Acreage of Public and NFS Lands in the Planning Area, identifies the amount of land managed by the BLM and FS in the planning area.

Table 3-3
Acreage of Public and NFS Lands in the Planning Area

State	BLM-Surface Acres	NFS- National Forest Acres	NFS- National Grasslands Acres[1]	Total Acreage
Alaska	5,860,536	2,732,322	-	8,592,858
Arizona	8,842,090	2,166,912	-	11,009,002
California	13,969,825	13,467,992	-	27,437,817
Colorado	6,288,740	15,092,198	786,000	22,166,938
Idaho	12,716,814	17,691,599	76,000	30,484,413
Montana	3,438,730	8,370,307	-	11,809,037
Nevada	45,991,073	6,221,008	-	52,212,081
New Mexico	9,507,142	8,314,108	-	17,821,250
Oregon	14,025,425	14,579,444	167,000	28,771,869
Utah	10,766,598	3,056,933	-	13,823,531
Washington[2]	--	6,430,898	-	6,430,898
Wyoming	11,747,232	2,863,442	1,566,000	16,176,674
Total	**143,154,205**	**100,987,163**	**2,595,000**	**246,736,368**

[2] Acreage calculations for Oregon and Washington are combined because states share one single BLM state-level office.
Source: BLM 2008c; FS2008a; [1]Olson 1997

United States Department of Agriculture, Forest Service

The National Forest Management Act of 1976 amended the Forest and Rangeland Renewable Resources Planning Act of 1974, which called for the management of renewable resources on NFS lands. The National Forest Management Act requires the Secretary of Agriculture to assess NFS lands, develop a management program based on multiple-use, sustained-yield principles, and implement a resource management plan for each unit of the NFS. The primary statues which authorize the disposal of renewable resources on NFS lands include the Organic Administration Act, Multiple-Use Sustained-Yield Act and the Bankhead-Jones Farm Tenant Act.

The FS is the federal agency responsible for the administration of the 191 million acres of land that comprise the NFS (Olson 1997). These lands consist of national forests and grasslands. The largest component of the NFS is the national forests. There are 155 national forests that contain more than 187 million acres. This amounts to almost 98 percent of the total acreage in the NFS.

The second largest component of the NFS is the national grasslands (Olson 1997). The FS currently administers 20 national grasslands consisting of

3,842,278 acres. National grasslands are located in 13 states. However, nine national grasslands consisting of 3,161,771 acres are in the Great Plains states of Colorado, North Dakota, South Dakota, and Wyoming. National grasslands in these four states alone contain more than 82 percent of the total national grassland acreage.

Bureau of Land Management

The BLM manages public lands under the authority of the Federal Land Policy and Management Act of 1976, Public Law 94-579, (43 USC 1714) (FLPMA). FLPMA provides direction for land use planning, administration, range management, rights-of-way, designated management areas (including specific locations and general designation of wilderness areas), and effects on existing rights (BLM 2008i).

The BLM is responsible for carrying out a variety of programs for the management and conservation of resources on 258 million surface acres, as well as 700 million acres of subsurface mineral estate (BLM 2008f). These surface acres comprise about 13 percent of the total US land surface and more than 40 percent of all land managed by the federal government.

Most of the public lands located in the western US, including Alaska, are characterized predominantly by extensive grassland, forest, high mountains, arctic tundra, and desert landscapes (BLM 2008j). The BLM manages multiple resources and uses, including energy and minerals; timber; forage; recreation; wild horse and burro herds; fish and wildlife habitat; wilderness areas; and archaeological, paleontological, and historical sites. In addition to its minerals management responsibilities, the BLM administers mineral leasing and oversees mineral operations on federal mineral estate underlying other state, private, or federally administered land, and manages most mineral operations on Indian lands.

The BLM administers approximately 57 million acres of commercial forests and woodlands through the Management of Lands and Resources and the Oregon and California Grant Lands appropriations (BLM 2008j). Under its multiple-use management mandate, the BLM administers more than 18,000 livestock grazing permits and leases and nearly 13 million authorized livestock AUMs on 160 million acres of public rangeland. The BLM also manages herd management areas and facilities for 57,000 wild horses and burros.

The BLM has an active program of soil and watershed management on 175 million acres in the lower 48 states and 86 million acres in Alaska (BLM 2008j). The 258 million acres of public lands include over 117,000 miles of fisheries habitat. Practices such as revegetation, protective fencing, and water development are designed to conserve and enhance public land, including soil and watershed resources.

Land Use Authorizations

Land use authorizations include various authorizations and agreements to use BLM-administered land, such as right-of-way (ROW) grants, road use agreements, and associated temporary use permits. Land use authorizations are issued for a variety of purposes, both short and long term. Short-term uses include agricultural leases, military training areas, and other uses involving minimal land improvements or disturbances. Long-term uses include rights-of-way grants for power lines, highways, roads, pipelines, fiber optics, communication sites, electric power generation sites, and irrigation.

Rights-of-way and Utility Corridors

As a general rule, a ROW is needed whenever a project is built on public lands (BLM 2008e). A ROW grant is an authorization to use a specific piece of public land for a certain project, such as roads, pipelines, transmission lines, and telephone lines. The grant authorizes rights and privileges for a specific use of the land for a specific period of time. Generally, a BLM or FS ROW is granted for a term commensurate with the life of the project. Typically, BLM grants are issued with 30-year terms, and most can be renewed. A more complete explanation of the BLM ROW program is found in Title 43 CFR 2800 and 2880. The BLM has also initiated efforts to streamline the application processing procedures (Instruction Memorandum No. 96-27 and Instruction Memorandum No. 97-18). A FS grant remains in effect unless terminated by mutual agreement or one agency giving the other 90 days prior written notice (FS 2003a). A more complete description to the FS ROW program is found in FS Manual 5460.

The EPAct of 2005 includes various initiatives directed at securing the nation's energy future, which include authorizing the US DOE in collaboration with federal land management agencies to designate corridors for energy transmission on federal lands within the 11 contiguous western states. The PEIS for Designation of Energy Corridors on Federal Land in the 11 Western States (US DOE and BLM 2007) considers 11 contiguous western states for the possible construction, operation, maintenance, and decommissioning and dismantling of energy infrastructure such as oil and gas pipelines and electric transmission lines; the states considered are Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. Geothermal resource development would use energy corridors to distribute electricity (US DOE and BLM 2007).

Land Use Permits and Leases

A lease is an authorization to possess and use public land for a fixed period of time. A lease is issued when there is going to be substantial construction, development, and improvement and there is an investment of large amounts of capital that will be amortized over time. Permits are authorized when uses of public lands will be short term and involve little or no land improvement, construction, or investment. Permits and leases are subject to process and monitoring fees and a fair market rental value.

Withdrawals

A land withdrawal is a real estate management tool to implement resource management planning prescriptions or to transfer administrative jurisdiction from one federal agency to another (BLM 2008c). A withdrawal creates a title encumbrance on the land, thereby restricting an agency's ability to manage its lands under multiple use management principles. The restrictions generally segregate the lands from some or all the public land laws and some or all of the mining and mineral leasing laws for a specific period of time, generally 20 years for post-FLPMA withdrawals. Withdrawn land can be closed to mining, mineral leasing, or mineral material disposal.

There are four major categories of formal withdrawals: administrative; Presidential Proclamations; Congressional; and Federal Power Act or Federal Energy Regulatory Commission Withdrawals (BLM 2008d). Withdrawals accomplish one or more of the following: transfer total or partial jurisdiction of federal land between federal agencies; close (segregate) federal land to operation of all or some of the public land laws and/or mineral laws; and dedicate federal land to a specific public purpose.

Split Mineral Estate

Public and NFS land ownership can involve split mineral estate situations, which involve separate surface ownership than subsurface ownership. For example, a parcel may contain private surface ownership and federal subsurface ownership, or it may contain federal surface ownership and private subsurface ownership. Through various acts, the federal government has retained mineral values, while encouraging settlement. As late as the 1980s, BLM policy concerning mineral estate was to reserve all oil and gas rights, as well as any other mineral values. Those lands on which the US reserved minerals and where they contain valuable mineral resources are generally kept in federal ownership. Many of the private surface owners have requested that the subsurface minerals be sold or transferred to their ownership.

3.2.2 Special Designations

The following section describes special management designations on public and NFS lands in the project and planning areas. These special areas have been designated to protect unique characteristics and contain resources that have been identified as scientifically, educationally, or recreationally important. Special management is administered with the intent to improve the manageability of the areas, allowing the BLM and FS to preserve, protect, and evaluate these significant components of national heritage. Special area designations on public and NFS lands can be established by Congress, Presidential Proclamation, or administratively. The BLM and FS have the authority to adopt special management designations through RMP or Forest Plan amendments or revisions.

Areas Designated by Congress or Presidential Proclamation

Congressional designations (Table 3-4) include Wilderness, National Conservation Areas, National Scenic Areas, National Recreation Areas, rivers in the National Wild and Scenic Rivers System, National Trails (discussed in detail under Section 3-16, National Scenic and Historic Trails) and Other Congressionally Designated Areas. The Steens Act Mineral Withdrawal Area is a Congressional designation specific to southeastern Oregon. National Monuments are designated by Presidential Proclamation or less commonly by Congressional designation. In instances where designations occur by an Act of Congress or Presidential Proclamation, the law or order designating each area provides specific objectives and guidelines for that area's management. Neither the BLM nor the FS has jurisdiction over lands other than public or NFS lands, respectively, within nationally designated areas.

Wilderness Areas

These areas are part of the National Wilderness Preservation System to ensure preservation and protection of their natural conditions. Nationwide, the FS manages more Wilderness areas (418) than any other agency, followed by the BLM (189). In the project area, there are a total of 408 Wilderness areas; California contains the most Wilderness areas (137), followed by Arizona (90), Nevada (68), and Alaska (48). In the planning area, there are 362 Wilderness areas. Activities and uses that do not support management objectives of these areas are prohibited. As such, subject to valid existing rights, Wilderness areas are withdrawn from all forms of mineral entry, location, and patent under the mining laws, and from disposition under all laws pertaining to mineral leasing.

National Conservation Areas

National Conservation Areas are designated mainly for the purpose of protecting natural or cultural resources. They may also be established to protect a variety of ecological, scenic, scientific, riparian, and recreation values. While most are managed for resource protection and recreation, activities such as grazing, logging, mining, and other commercial enterprises are often permitted. There is no single congressional act that guides the management of these areas. Instead, the particular Act that authorizes designation of each National Conservation Area identifies the unique values to be protected and any other specific management guidelines to be followed. In the project area, the BLM manages 17 National Conservation Areas, and the FS manages none. In the planning area, the BLM manages 15 National Conservation Areas, and the FS manages none.

Table 3-4
Congressional, Presidential, and Administrative Special Designation Areas on Public and NFS Lands in the Project and Planning Areas

Agency	Acreage									
	Congressional Designations							Administrative Designations		
	Wilderness Areas	National Conservation Areas	National Scenic Area	National Recreation Area	Wild and Scenic Rivers	Other Congressionally Designated Areas (FS)[1]	National Monuments	Wilderness Study Areas	Areas of Critical Environmental Concern (BLM)[2]	National Forest Inventoried Roadless Areas (FS)[3]
BLM (Project Area)	7,663,272	15,291,405	-	-	631,605	-	4,770,225	13,641,594	12,450,547	-
BLM (Planning Area)	6,441,930	2,223,694	-	-	333,254	-	1,288,035	10,050,923	8,243,565	-
FS (Project Area)	32,352,798	-	199,705	2,258,250	604,110	2,021,534	310,784	3,227,819	-	52,934,355
FS (Planning Area)	19,057,887	-	180,299	1,709,808	310,140	1,177,521	192,228	788,597	-	31,457,013
Total (Project Area)	**40,016,070**	**15,291,405**	**199,705**	**2,258,250**	**1,235,715**	**2,021,534**	**5,081,008**	**16,869,413**	**12,450,547**	**52,934,355**
Total (Planning Area)	**25,499,817**	**2,223,694**	**180,299**	**1,709,808**	**643,394**	**1,177,521**	**1,480,264**	**10,839,520**	**8,243,565**	**31,457,013**

1 Other Congressionally-Designated Areas are a FS-specific designation
2 Areas of Critical Environmental Concern are a BLM-specific designation
3 National Forest Inventoried Roadless Areas are a FS-specific designation
Source: BLM 2008c, FS 2008a

National Scenic Areas

These areas are designated to protect the scenic, cultural, historic, recreational, and natural resources in specific areas, while allowing compatible uses. The management policies for a specific National Scenic Area are set forth in the legislation designating it. In the project area the FS manages five National Scenic Areas. In the planning area, the FS manages three National Scenic Areas. No National Scenic Areas in the project or planning area are managed by the BLM.

National Recreation Areas

This designation was established primarily to protect important recreation, scenic, scientific, and natural values for the enjoyment of current and future generations. The activities center on water- and land-based activities associated with the natural environment. The uses and activities allowed within National Recreation Areas depend on the law designating the area and can vary widely. The FS manages 32 National Recreation Areas in the project area and nine in the planning area. No National Recreation Areas within the project or planning area are managed by the BLM.

Rivers in the National Wild and Scenic Rivers System

To effectively manage these special river segments, Congress established the National Wild and Scenic Rivers System. Rivers, or segments of rivers, must be free flowing and possess at least one outstandingly remarkable value, such as scenic, recreational, geologic, fish, wildlife, historic, cultural, or other features. The Bureau has many rivers not congressionally designated under the Act, but found to be eligible under the act. The outstandingly remarkable values of eligible rivers must be protected until superseded by Congress. Within the National Wild and Scenic Rivers System, three classifications define the general character of designated rivers: wild, scenic, or recreational. Classifications reflect levels of development and natural conditions along a stretch of river. These classifications are used to help develop management goals for the river.

There are approximately 1,235,715 acres of rivers in the National Wild and Scenic Rivers System in the project area and approximately 643,384 acres in the planning area. Nationwide, the northwestern states of Alaska, Washington, Oregon, Montana, and Idaho contribute well over half of the rivers to the National Wild and Scenic Rivers System, with Oregon leading the US with 48 designated rivers (National Wild and Scenic River System 2007). Four federal agencies cooperatively manage the congressionally designated rivers where rivers flow through federal lands. On federal lands, the National Park Service manages the most segments (29 percent), followed by FS (27 percent), BLM (22 percent), and USFWS (19 percent). The remaining river segments (less than 3 percent) are administered by a state.

National Monuments

These areas are designated to protect unique resources identified within the monument boundaries. National Monuments are managed by the BLM, FS, USFWS and NPS. Federal lands in National Monuments are generally closed to mineral development subject to valid existing rights. One exception is the Canyons of the Ancients National Monument in southwestern Colorado, which permits new leasing for oil and gas where a lessee makes a discovery on an existing lease and efficient recovery of the oil and gas resources requires drilling, or where necessary to protect oil and gas resources on federal lands against drainage.

Administrative Designations

At their discretion, both the BLM and FS may apply administrative designations (Table 3-4) in areas requiring special management. Administrative designations are not legislative. Special areas that are designated administratively by the BLM include Areas of Critical Environmental Concern (ACECs), Research Natural Areas, National Natural Landmarks, Backcountry Byways, and Watchable Wildlife Areas. Special areas designated by the FS include WSAs, Research Natural Areas, and Inventoried Roadless Areas. In addition, for the purposes of analysis in this PEIS, Wilderness Study Areas (WSAs) are also evaluated under administrative designation, however only Congress can provide additional direction for these areas.

Uses are permitted in the administratively designated areas to the extent that the uses are in harmony with the purpose for which the area was designated. All of the areas identified under this section would be closed to geothermal leasing or would be open with major constraints.

Wilderness Study Areas

The BLM and FS manage approximately 13,641,594 and 310,784 acres of WSAs in the project area, respectively. In the planning area, the BLM and FS manage approximately 10,050,923 and 788,597 acres of WSAs, respectively. The agencies are responsible for managing WSAs in such a manner to prevent impairment of their suitability for congressional designation as wilderness. The WSA designation remains until Congress makes a final decision on whether to designate the WSA as Wilderness, adding it to the National Wilderness Preservation System, or to release the lands from wilderness review. There are no time limitations on Congress, so it is uncertain when final decisions will be made on any WSA designation.

Areas of Environmental Concern

The FLPMA states that the BLM will give priority to the designation and protection of ACECs in the development and revision of land use plans. The ACEC designation is an administrative designation unique to the BLM; no other agency uses this form of designation. The ACEC designation indicates to the public that the BLM recognizes that an area has significant values and has established special management measures to protect those values. In addition, an ACEC designation also serves as a reminder that significant values(s) or resource(s) exist that must be accommodated when future management actions and land use proposals are considered near or within an ACEC. These ACECs differ from other special management designations, such as WSAs, in that designation by itself does not automatically prohibit or restrict other uses in the area. The one exception is that a mining plan of operation is required for any proposed mining activity within a designated ACEC. In the project area, the BLM manages 794 ACECs encompassing approximately 12,450,547 acres. In the planning area, the BLM manages 616 ACECs comprising approximately 8,243,565 acres. Appendix C identifies which ACECs are open or closed to fluid mineral leasing and what stipulations are required in areas open to leasing.

Inventoried Roadless Area

This FS-specific administrative designation represents some of the nation's most highly valued expanses of open space. Under this designation, approximately 58.5 million acres are conserved nationwide, or 31 percent of NFS lands, totaling about 2 percent of the total US land base. Nationwide, approximately 25 percent of the total acres of inventoried roadless areas are in Alaska. Another 72 percent of the nationwide total is in the remaining 11 states of the project area. The remaining 3 percent is outside the project area. In the project area, there are approximately 52,934,355 acres of inventoried roadless areas; and in the planning area, there are approximately 31,457,013 acres of inventoried roadless areas.

3.2.3 Recreation

Recreation opportunities on public and NFS lands range from dispersed uses, such as hiking and wildlife viewing, to developed recreation, including campgrounds and interpretive sites. Recreation is an important component of the multiple use management practices carried forth by both the BLM and FS. Recent surveys by these agencies demonstrate that recreational use on public and NFS lands is increasing annually. Steady population growth continues to increase the recreational demand on undeveloped public and NFS lands as visitors and nearby residents seek a diversity of recreational opportunities.

The Recreation Opportunity Spectrum is both a classification system and a prescriptive tool for recreation planning, management, and research (Clark and Stankey 1979). It is used by both the BLM and FS to illustrate the recreational setting by describing a combination of the physical, biological, social, and managerial conditions that give value to a place. The Recreation Opportunity Spectrum embodies six land classes: primitive; semiprimitive, nonmotorized; semiprimitive, motorized; roaded, natural; rural; and urban. Each setting prompts experiences that range from a sense of isolation and closeness to nature (at the primitive end of the spectrum) to social experiences in highly structured environments (at the urban end of the spectrum). The immense landscape of the project area contains a variety of recreation settings and opportunities allowing visitor to select the experiences most closely matching their reason for using public and NFS lands.

United States Department of Agriculture, Forest Service

Many people use NFS lands, waters, and recreation sites for physical exercise, nature exploration, and as an important means of relaxation (FS 2008a). The FS reports visitation estimates using standard definitions of national forest visits and national forest site visits. A national forest visit is defined as the entry of one person upon a national forest to participate in recreation activities for an unspecified period of time. A site visit is defined as the entry of one person upon a national forest site or area to participate in recreation activities for an unspecified period of time. In effect, a national forest visit is composed of one or more national forest site visits (FS 2008a).

According to the National Forest Visitor Use Monitoring Program, annual visitation to NFS lands nationwide is approximately 204.8 million national forest visits. Visitors averaged about 1.2 site visits for each national forest visit, or 245.9 million site visits. Included in the site visit total are 8.8 million site visits to designated Wilderness (FS 2008a).

Providing outdoor recreational opportunities is a primary goal identified in the FS Strategic Plan for Fiscal Years 2004 to 2008 (FS 2004a). More specifically, the FS recreational objectives are to:

- maximize opportunities for visitors to know and experience nature while engaging in outdoor recreation;
- develop and manage sites consistent with the available natural resources to provide a safe, healthful, esthetic, nonurban atmosphere; and
- provide a maximum contrast with urbanization at NFS sites (FS 2006a).

Many people visit NFS lands to camp, picnic, boat, or visit some other type of developed recreation facility. The top five activities pursued on NFS lands are viewing natural features, experiencing general relaxation, hiking, viewing wildlife, and pleasure driving (FS 2008a). Downhill skiing also is a popular activity in some regions.

Many of the facilities and services associated with FS recreation opportunities are free (FS 2008b). Some require fees or permits to help maintain, manage, and improve sites and facilities. Recreation permits may be required when extra measures are needed to protect natural or cultural resources. A Special Use Permit, which may include a fee, grants rights or privileges of occupancy and use to the holder. Examples include reserving a public site for a wedding party or holding a bicycle race on NFS lands. These permits contain specific terms and conditions that the holder must follow. Before Special Use Permits are issued, the FS must determine that the proposed use complies with all management plans and laws, that there is a demonstrated need for the activity, and that the use is appropriate on NFS lands. Special Use Permits are a temporary authority.

Bureau of Land Management

Public lands offer a number of diverse recreational opportunities. On more than 258 million acres of public lands, people enjoy several types of outdoor adventure, including camping, hunting, fishing, hiking, horseback riding, boating, whitewater rafting, hang gliding, off-highway vehicle driving, mountain biking, birding and wildlife viewing, taking photography, climbing, engaging in all types of winter sports, and visiting natural and cultural heritage sites. Recreational use on BLM-managed lands also helps support the economies of western communities and states. More than 22 million people now live within 25 miles of public lands, and two-thirds of public lands are within 50 miles of an urban area (BLM 2008g). Visits to recreation sites on public lands have significantly increased over the years, from just more than 51 million in 2001 to over 55 million in 2006, an almost 8-percent increase.

The BLM's outdoor recreation mission is to sustain healthy land and water resources while providing quality visitor services (BLM 2008f). The BLM's overall vision for outdoor recreation is "Visitors renewing their relationships with the land and respecting local cultures while enjoying quality recreation activities." The BLM provides resource-dependent recreational opportunities in a variety of settings that typify the vast western landscapes of the project area (BLM 2008f). These diverse settings range from Alaska's tundra to the deserts of the Southwest, and from the old growth forests of the Northwest to the plateaus and plains of the Rocky Mountain states. As a national provider of recreation, the BLM focuses on providing resource-based versus facilities-based recreation and tourism opportunities. Tourism generated by the recreation and leisure opportunities on public lands contributes significantly to the national economy, as well as to local economies (BLM 2008f). The BLM provides recreation opportunities in areas having national, regional, and local importance.

Recreational opportunities of regional and local importance are provided in a variety of settings on project area public lands: non-fee sites, rivers not in the National Wild and Scenic Rivers System (5,763 miles), and inventoried trails not in the National Trail System (7,468 miles) (BLM 2008f). While the BLM's focus is on providing resource-based recreation and tourism opportunities, the BLM provides facilities where necessary to protect resources and to serve as staging areas for resource-based recreation use. For the most part, however, facilities are not the attraction in and of themselves. In some areas, visitors are charged a recreation use fee or entrance fee to help cover the cost of facility maintenance and resource protection. The Federal Lands Recreation Enhancement Act (Public Law 108-447, Section 804) grants recreation fee authority to federal agencies including the BLM and FS to maintain and improve the quality of visitor amenities and services (BLM 2008h). It authorizes three fee categories: standard amenity fees, expanded amenity fees, and special recreation permits.

All public lands are allocated as a Special Recreation Management Area or an Extensive Recreation Management Area. A Special Recreation Management Area is a unit where specific recreation/tourism interests have expressed a desire for certain kind of activities, experiences, and other benefits. As such, these units are managed intensively for recreation, and the setting character in these units is a high priority. Areas with a Special Recreation Management Area allocation typically see investments in recreation facilities and visitor services. An Extensive Recreation Management Area is a unit with no identifiable market demand for structured recreation opportunities. Rather, an Extensive Recreation Management Area emphasizes the traditional dispersed recreation use of public lands. Extensive Management Areas are managed custodially; resources committed are generally limited and include provisions for visitor health and safety, and those aimed at reducing damage and mitigating user conflict. Visitors who want to avoid areas of intensive recreation activities generally prefer Extensive Recreation Management Areas. By default, anything not allocated as a Special Recreation Management Area becomes part of an Extensive Recreation Management Area.

Recreation Areas

The BLM and FS manage a diversity of recreation areas in the project area. These areas are managed and maintained for public use and offer a variety of opportunities such as camping, hiking, boating, interpretive programs, fishing, horseback riding, and wildlife viewing. Table 3-5, Number of BLM and FS Recreation Areas in the Project Area by State, lists the number of recreation areas managed by the BLM and FS in each state; these include campsites, trails not listed as nationally historic or scenic, sites at rivers and creeks not included in the National Wild and Scenic Rivers System, reservoirs, picnic sites, day-use areas, and certain multi-use recreational areas.

Table 3-5
Number of BLM and FS Recreation Areas in the Project Area by State[1]

State	Total # of BLM Recreation Areas in the Project Area	Total # of FS Recreation Areas in the Project Area[1]
Alaska	9	13
Arizona	38	49
California	41	298
Colorado	14	116
Idaho	50	103
Montana	4	55
Nevada	32	20
New Mexico	48	21
Oregon	49	107
Utah	83	153
Washington	11	98
Wyoming	38	52
Total	417	1,085

[1] Specially designated areas omitted from calculations include the following: Designated Critical Habitat, National Conservation Areas, National Game Refuge and Wildlife Preserves, National Historic Districts, National Historic and Scenic Trails, National Monuments, National Preserves, National Primitive Ares, National Protections Areas, National Recreation Areas, National Scenic Areas, National Scenic Research Areas, National Volcanic Monument Areas, National Wild and Scenic Rivers, (National) Wilderness Areas, Rental units (including cabins, lookouts, yurts, stations, kitchens, bunkhouses and A-frames), State Parks (Anasazi), Visitor, Discovery, and Information Centers, and Wilderness Study Areas.
Source: Recreation.gov (2008)

3.3 GEOLOGIC RESOURCES AND SEISMIC SETTING

The project area's geology is the result of large scale tectonic activity over hundreds of millions of years. The center of the North American continent, including central Canada and the central US, has been stable for over 600 million years. At the western edge, other pieces of crust have been added to the North American continent. The processes by which these pieces were added deformed the existing crust. The physiography (terrain texture, rock types, and geologic structure and history) of the western US is primarily a product of these additions and deformations.

The western states are made up of several physiographic provinces with generally similar terrain and geologic characteristics. These physiographic provinces include the Great Plains, Southern Rocky Mountain, Wyoming Basin, Middle Rocky Mountain, Northern Rocky Mountain, Basin and Range, Colorado Plateau, Columbia Plateau, Cascade-Sierra Mountains, Pacific Border, and Lower California provinces. The characteristics of the physiographic provinces and Alaska are discussed below (Figure 3-1).

Regional Geologic History

During the last half of the Mesozoic Era, much of today's California, Oregon, and Washington were added to the North American continent. As slabs of ocean crust sank beneath the western edge of the continent, some pieces of continental crust were added to the continent, while other pieces were carried along with the sinking ocean slab (USGS 2004a). About 200 to 300 miles inland, magma generated above the sinking ocean slab rose into the North American continental crust erupting out of dozens of individual volcanoes. Volcanic mountain ranges grew as lava and ash erupted, and great masses of molten rock were injected and hardened in place beneath the surface (USGS 2004a).

For 100 million years, the effects of plate collisions were focused very near the edge of the North American continent. Three major mountain-building episodes reshaped the western US from about 170 to 40 million years ago (Jurassic to Cenozoic Periods). It was not until 70 million years ago that these effects began to reach the Rocky Mountains, resulting in raising mountains far inland from the western edge of the continent (USGS 2004a).

The southwestern US is beginning to be pulled apart by extensional forces. These forces are due to molten rock flowing in the earth's mantle beneath the solid crust. The extension results in a thinning of the crust over the mantle. The volcanism in the Basin and Range and the Rio Grand Rift is associated with this crustal extension and thinning. The crustal extension and associated volcanic activity, although slow, is ongoing and is the source of much geothermal heat (USGS 2003a).

C://EMPSi/GeothermalPEIS/Figures

NO WARRANTY IS MADE BY THE BLM OR FS FOR USE OF THE DATA FOR PURPOSES NOT INTENDED BY THE BLM OR FS

SOURCE: BLM 2007c

There are 11 Physiographic Provinces in the 11 Western States

Physiographic Provinces of the 11 Western States

Figure 3-1

3.3.1 Characteristic by Physiographic Province

Great Plains

Physiography

The Great Plains physiographic province includes the west-central US, including eastern Montana, eastern Wyoming, eastern Colorado, and eastern New Mexico within the project area (Figure 3-1).The province is characterized by flat to rolling prairie with scattered hills and bluffs gradually rising westward to abruptly give way to the frontal ranges of the Rocky Mountains in the Southern Rocky Mountain and Basin and Range physiographic provinces (USGS 2002). With the exception of the Black Hills of South Dakota, with altitudes of 7,000 feet, the entire region has low relief (USGS 2002, USGS 2004b).

Geology

The Great Plains is a vast region that spreads across the stable core of North America. This area formed when several small continents collided and welded together over a billion years ago during the Precambrian. Precambrian metamorphic and igneous rocks form the basement of the Great Plains and make up the stable nucleus of North America. The province has experienced more than 500 million years of relative tectonic stability, remaining relatively unaffected by the mountain-building tectonic collisions suffered by the western and eastern margins of the continent (USGS 2004b).

During part of the Jurassic (208 to 144 million years ago), rising seas flooded the low-lying areas of the continent. Much of the Great Plains eventually lay submerged beneath shallow seas with sediments eroding from the rising Rocky Mountain deposited as layered wedges of fine debris. As sand, mud, and clays accumulated, the seas retreated northward. Once again, during the Cretaceous (144 to 65 million years ago), record high sea levels flooded the continental interior with shallow seas (USGS 2004b). The flatness of the Great Plains is a reflection of the platform of mostly flat-lying marine and stream deposits laid down in the Mesozoic and Cenozoic Eras (USGS 2004b). Uplifts, such as the Black Hills Uplift in eastern Wyoming and western South Dakota, are places where the Paleozoic and younger sedimentary rocks have been eroded away and crystalline rocks are exposed (USGS 2002).

Southern Rocky Mountains

The Southern Rocky Mountains are part of the Rocky Mountain System, a discontinuous series of mountain ranges that extend from central New Mexico northwest to the Canadian border (Figure 3-1). The system also includes the Middle Rocky Mountain, Northern Rocky Mountain, and Wyoming Basin provinces (USGS 2003a).

Physiography

West of the frontal ranges in Colorado and northern New Mexico are additional and higher mountain ranges generally oriented north-south but with many spurs and extensions oriented in other directions. These ranges are separated by valleys and high mountain parks. The ranges include 54 mountain peaks higher than 14,000 feet. Most of these high peaks are located near the Continental Divide, which extends approximately north-south through central Colorado and western New Mexico. The altitude of the divide decreases in southern New Mexico to less than 4,500 feet in some areas (USGS 2002).

Geology

The last major mountain-building event affecting the western US (about 70 to 40 million years ago) is responsible for raising the Rocky Mountains (USGS 2004a). Prior to the mountain-building uplifts, most of the area was covered by an extensive layer of sediments that had been deposited during the previous millions of years. These layers of sediment were gradually buried and altered to form layers of rock. The Great Plains province to the east of the Southern Rocky Mountains is still underlain by a relatively flat and undeformed sequence of these rocks (USGS 2002).

The uplift of the Rocky Mountains faulted, deformed, and elevated the land surface and the underlying ordered layers of rock. Faulting was prevalent, and a few faults developed more than 20,000 feet of vertical offset. As uplift continued, erosion removed the uppermost rocks and, in some areas, exposed the underlying crystalline-rock core of the mountains (USGS 2002). Many of the individual ranges that make up the Rocky Mountains are made up of a core of uplifted Precambrian granite surrounded by Paleozoic and Mesozoic sedimentary rocks that once overlay the uplifted blocks. Erosion throughout the Tertiary period exposed the uplifted blocks and filled valleys with deposits derived from both the Paleozoic and Mesozoic rocks and the Precambrian cores (USGS 2003a).

Rocks of various geologic age have a wide surficial distribution because of the depositional history and deformation of the area. Deformation caused extensive faulting, and faults commonly separate adjacent geologic units (USGS 2002).The Southern Rocky Mountains province is beginning to be pulled apart by extensional forces. The physiographic feature associated with this extension is the Rio Grande Rift, a long fault-bounded basin through which the upper Rio Grande River flows southward through New Mexico. Volcanism accompanies this extension. Inside the Rio Grande Rift, lava from a source deep in the mantle has periodically erupted. Among the larger volcanoes is the Valles Caldera in north-central New Mexico (USGS 2003a). The crustal extension and associated volcanic activity, although slow, is ongoing and is the source of much of the geothermal heat present in New Mexico and southern Colorado (USGS 2003a).

Wyoming Basin

Physiography

The Wyoming Basin is primarily in south-central Wyoming but also extends into northern Colorado (Figure 3-1). The Basin consists of a series of broad intermountain basins lying between isolated hills and low mountains between the Southern and Middle Rocky Mountains (BLM 2003a) The major basins within this province include the Greater Green River, Wind River, Laramie, and Hanna Basins. Within each of the major basins, there are numerous sub-basins.

Geology

During Paleozoic time, present-day Wyoming and much of the Rocky Mountain west were located along a fairly stable continental shelf with the land areas to the east. The area was generally inundated by shallow seas and fluctuations in sea level, which resulted in the deposition or erosion of sediments. Uplift and erosion of the Ancenstral Rocky Mountains during the Pennsylvanian resulted in the deposition of sandstones before a return of a shallow marine environment with repeated fluctuations in sea level (BLM 2003b).

Near the end of the Cretaceous, mountain building began again in the western Wyoming-eastern Idaho Thrust Belt. As the mountains were uplifted, erosion occurred and sediment was shed into the shallow seas to the east. At the end of the Cretaceous and the beginning of Tertiary time, another episode of mountain building (the Southern Rocky Mountains) was occurring to the east and southeast of the area involving the uplift of the Precambrian basement (BLM 2003b).

The uplifted blocks of basement rock were eroded and the sediment was deposited in the surrounding basins. In Oligocene and Miocene time, large volcanic eruptions occurred to the west and north of the area depositing thick layers of ash. Also in later Tertiary time, one more episode of uplift occurred, again resulting in the deposition of material in the basins. The late Tertiary deposits were subjected to erosion, and by the end of Tertiary time and the beginning of Quaternary time, the present-day topography began to emerge (BLM 2003b).

Middle Rocky Mountains

Physiography

The ranges of the Middle Rocky Mountain province cover most of northwestern Wyoming and extend north into Montana, west into Idaho, and southwest into Utah and Colorado (Figure 3-1). The province is separated from the Southern Rocky Mountains to the southeast by the Wyoming Basin. The ranges of this province are generally lower and less continuous than those to the south. The highest peaks of the Middle Rockies are Gannet Peak (13,785 feet) in the Wind River Range and Grand Teton (13,766 feet) in the Teton Range (Columbia Encyclopedia, 2007).

Geology

Before the Laramide mountain-building period, the Middle and Southern Rockies were part of a stable platform composed of Precambrian crystalline rocks. The platform received sediments that were transformed into sedimentary rocks, which were then uplifted and eroded during the mountain-building period. Later, volcanic activities produced mountains and high plateaus in many places (US DOE ad BLM 2007).

Tectonic forces that acted on the region produced large areas of subsidence and uplift. The smaller intermontane basins are less than 3,000 feet deep. The amount of uplift in the segment likewise varies considerably (USGS 2002).

Geologic structures, such as faults, anticlines, and synclines, are numerous and complex in the Middle Rocky Mountains in Wyoming. Older rocks have been lifted upward and shifted eastward over younger rocks along thrust faults in the Teton Range. The principal parts are the Wasatch and Teton ranges (which are both great tilted fault blocks); the Yellowstone Plateau and Absaroka Range (both developed on volcanic rocks); and the Bighorn, Beartooth, Owl Creek, and Uinta Mountains, and the Wind River Range (all broad folded mountains). All of these component sections have been eroded down to their Precambrian cores and are rimmed by Paleozoic and Mesozoic sedimentary rocks (Columbia Encyclopedia, 2007). Thick sequences of Paleozoic and younger sedimentary rocks have been downfolded into the numerous basins in the Wyoming Basin. Where these sedimentary rocks have been upfolded into anticlines that separate the basins, the rocks have been partly or completely removed by erosion, and older, mostly crystalline rocks are exposed along the axes of the uplifts or anticlines. In Yellowstone National Park, Quaternary volcanic rocks overlie the crystalline rocks (USGS 2002).

Northern Rocky Mountains

Physiography

The Northern Rocky Mountain province is located in western Montana and northern Idaho (Figure 3-1). The province is characterized by low mountains with summits between 6,900 and 7,874 feet above sea level (US DOE and BLM 2007).

Geology

The Rocky Mountains include fault-bounded uplifts, folded mountains, and highlands formed by volcanism resulting from the mountain-building period that occurred between the middle Cretaceous and late Eocene Periods. The uplift also set the stage for the geomorphic evolution of the Rocky Mountains, producing ridges and plateaus high enough to be glaciated, as well as many of the region's streams and canyons (US DOE and BLM 2007). Geologic structures, such as faults, anticlines, and synclines, are numerous and complex in the Northern Rocky Mountains. Older rocks have been lifted upward and shifted eastward over younger rocks along thrust faults near the Continental Divide and in the Teton Range (USGS 2002).

Precambrian rocks are exposed in western Montana and in Wyoming. Sedimentary rocks of Precambrian age crop out over a wide area in western Montana. In Wyoming and southwestern Montana, Precambrian rocks mostly are plutonic igneous rocks but also include several types of metamorphic rocks. (USGS 2002).

Paleozoic sedimentary rocks are exposed at the land surface mostly in mountainous areas where they flank uplifts or anticlines, or have been displaced upward along faults (USGS 2002a). Mesozoic (chiefly Cretaceous) sedimentary rocks are exposed over wide areas in Montana and Wyoming (USGS 2002). Mesozoic igneous intrusive rocks are common in central Idaho (US DOE and BLM 2007).

Large areas of Tertiary intrusive and volcanic rocks are present in northwestern Wyoming and western Montana (USGS 2002). Tertiary and Quaternary valley-fill deposits occur in western Montana and Wyoming, and Quaternary silicic volcanic rocks are in small areas in northwestern Wyoming and southwestern Montana.

Basin and Range

Physiography

Centered on Nevada and extending from eastern California to central Utah, and from southern Idaho into Sonora, Mexico, the Basin and Range province can be divided into the Great Basin in the north and the Salton Trough, Mojave-Sonoran Desert, Mexican Highlands, and Sacramento Mountains in the south (Figure 3-1) (USGS 2003a , US DOE and BLM 2007). The Basin and Range province has a characteristic topography, with more than 400 evenly spaced, nearly parallel mountain ranges and intervening basins. The mountain ranges are generally abrupt, steeply sloping, and deeply dissected with relief between 3,000 and 5,000 feet above the intermountain basins. The basins are typically broad, gently sloping, and largely undissected with altitudes from below sea level to about 5,000 feet above sea level (US DOE and BLM 2007).

Geology

The Basin and Range province was created about 20 million years ago as the earth's crust stretched, thinned, and then broke into some 400 mountain blocks that partly rotated from their originally horizontal positions (USGS 2003a). Along roughly north-south-trending faults, mountains were uplifted and valleys down-dropped, producing the province's distinctive alternating pattern of linear mountain ranges and valleys or basins (USGS 2002).

The mountain ranges consist of complexly deformed late Precambrian and Paleozoic rocks and some Mesozoic granitic rocks in the western part of the province. Cenozoic volcanic rocks are widespread throughout the province (US DOE and BLM 2007). These uplifted rocks erode and fill the intervening valleys and basins with fresh sediment (USGS 2003a). These basins generally contain an underlying, relatively undeformed sequence of rock that was deposited in the area prior to uplift and an overlying younger layer of rock and sediment that was derived from the erosion of nearby uplifted areas. Some of these basins contain older sedimentary rocks or volcanic rocks, and almost all contain a thick overlying sequence of Tertiary and Quaternary sediment derived from erosion of nearby uplifted blocks (USGS 2002).

Within the province, the earth's crust has been stretched up to 100 percent of its original width. The entire region has been subjected to extension that thinned and cracked the crust as it was pulled apart, creating large faults.

Colorado Plateau

Physiography

The Colorado Plateau includes the High Plateaus of Utah, Uinta Basin, Canyon Lands, Navajo section, Grand Canyon section, and Datil section (Figure 3-1) (USGS 2003a). The province is a vast region of plateaus, mesas, and deep canyons. Uplift of the Colorado Plateaus steepened stream gradients and accelerated the downcutting of the Colorado River and its principal tributaries. Downcutting of the Colorado River in the Grand Canyon has exposed thousands of feet of sedimentary rocks (USGS 2002).

Geology

Ancient Precambrian metamorphic rocks formed during continental collisions over a billion years ago make up the basement of the Colorado Plateau. Igneous rocks were injected millions of years later. These basement level rocks were uplifted and eroded until, by 600 million years ago, they had been beveled off to a smooth surface upon which younger rocks were deposited (USGS 2004a).

During the next 300 million years, the Colorado Plateau region was periodically inundated by tropical seas. Thick layers of limestone, sandstone, siltstone, and shale were laid down in the shallow marine waters. During times when the seas retreated, stream deposits and dune sands were deposited or older layers were removed by erosion (USGS 2004a). About 250 million years ago deposits of marine sediment waned and terrestrial deposits dominated. Eruptions from volcanic mountain ranges to the west buried vast regions beneath ashy debris. Short-lived rivers, lakes, and inland seas left sedimentary records of their passage. The Colorado Plateau is remarkable stable. Relatively little rock deformation (e.g., faulting and folding) has affected this high, thick crustal block within the last 600 million years (USGS 2004a).

Beginning about 20 million years ago, both the Basin and Range and Colorado Plateau regions were uplifted as much as almost two miles. Great tension developed in the crust, probably related to changing plate motions far to the west. As the crust stretched, the Basin and Range province broke up into a multitude of down-dropped valleys and elongate mountains. The neighboring Colorado Plateau preserved its structural integrity and remained a single tectonic block. Eventually, the great block of Colorado Plateau crust rose over one-half mile higher than the Basin and Range. As the land rose, the streams responded by cutting ever deeper stream channels, including the Grand Canyon (USGS 2004a).

Columbia Plateau

Physiography

The Columbia Plateau province includes southeastern Washington, northwestern Oregon, and most of southern Idaho (Figure 3-1). The province includes the Walla Walla Plateau, Blue Mountain section, Payette section, Snake River Plain, and the Harney section (USGS 2003a). The topography of the Columbia Plateau province is dominated by geologically young lava flows that inundated the countryside within the last 17 million years. The province is enveloped by one of the world's largest accumulations of lava (over 193,000 square miles). Over 220 million cubic yards of basaltic lava, known as the Columbia River basalts, covers the western part of the province. The Snake River Plain lies in a distinct depression (USGS 2004c). The Snake River Plain stretches across Oregon, through northern Nevada and southern Idaho, and ends at Wyoming's Yellowstone Plateau. Looking like a great spoon scooped out the earth's surface, the smooth topography of this province forms a striking contrast with the rugged mountainous fabric around it.

Geology

Between 14 and 16 million years ago, fissure volcanic eruptions in eastern Washington, eastern Oregon, and western Idaho produced enormous volumes of molten Columbia River lava that flowed west into eastern Washington and northeastern Oregon, with some lava continuing to flow as far west as the Pacific Ocean via the ancestral Columbia River valley. The lava eventually accumulated to a thickness of more than 6,000 feet. As the molten rock came to the surface, the earth's crust gradually sank into the space left by the rising lava. The subsidence of the crust produced a large, slightly depressed lava plain now known as the Columbia Basin (Plateau) (USGS 2003b). With the end of the outpouring of lava, tremendous forces deep within the earth began to warp the plateau in several places. A general uplift of the mountainous region in the north caused the entire plateau to tilt slightly to the south.

The Columbia River Basalt was created by tremendous eruptions between 17 and 6 million years ago, with most erupting in the first 1.5 million years. In the west, the Columbia River Basalts are almost exclusively black basalt (USGS 2004c).

The western end of the Snake River Plain is formed by a block down dropping between normal faults, known as a horst and graben structure. Although there is extensive faulting at the eastern end, the structure is not as clear. The earliest Snake River Plain eruptions began about 15 million years ago, just as the tremendous early eruptions that created Columbia River Basalt were ending.

But most of the Snake River Plain volcanic rock is less than a few million years old and younger. The Snake River Plain eruptions produced soupy black basaltic lava flows alternated with tremendous explosive eruptions of rhyolite, a light-colored volcanic rock (USGS 2004c).

Volcanic cinder cones dot the landscape of the Snake River Plain, along with calderas (great pits formed by explosive volcanism), low shield volcanoes, and rhyolite hills. Many of these features are obscured by later lava flows (USGS 2004c).

The volcanic activity is thought to be due to a concentrated heat source, or hot spot, that melted the rock beneath the Columbia Plateau province. Scientists have determined that the youngest volcanic rocks are clustered near the Yellowstone Plateau, and that the farther west they investigated, the older the lava rocks. This data led to the theory that an extremely hot plume of deep mantle material has risen and continues to rise to the surface beneath the Columbia Plateau province. It has caused and continues to cause eruptions as the North American plate is moving over it, leaving a record of plate motion rate and direction. The hot spot is thought to currently be under Yellowstone National Park. The steaming fumaroles and explosive geysers are ample evidence of a heat concentration beneath the surface (USGS 2004c). The Yellowstone Caldera is a large crater-like feature covering more than 1,300 square miles. It formed when an underground magma chamber collapsed after an eruption 630,000 years ago (USGS 2003a).

Cascade-Sierra

Physiography

The Cascade-Sierra province includes the Sierra Nevada in central California and Nevada in the south, and the Southern Cascade Mountains, Middle Cascade Mountains, and Northern Cascade Mountains in northern California, Oregon, and Washington (Figure 3-1)(USGS 2003a). The Cascade and Sierra Nevada ranges are part of the large mountain chain stretching more than 12,000 miles from Tierra del Fuego to the Alaskan Peninsula (USGS 2000). Extending from 14,494 feet (Mt. Whitney, the highest peak in the lower 48 states) in the east to near sea level in the west, the Sierra Nevada contains Yosemite and Sequoia National Parks (USGS 2003a).

The great length and strong north-south linearity of the Middle and Southern Cascade ranges, a narrow band extending from southern Washington to northern California (roughly parallel to the Pacific coastline), contrasts sharply with the varied directional trends of other mountain groups to the east and northeast. These mountain ranges contain 13 major volcanic centers with large and geologically recent active volcanoes that dominate the landscape (USGS 2000).

The North Cascade Range is steeper and wetter than most other continental US ranges. The peaks of the North Cascades reach elevations of 7,000 to 8,000 feet, with relatively large uninterrupted vertical distances from valley bottom to mountain top of 4,000 to 6,000 feet (USGS 2000). The deep canyons and sharp peaks are products of profound erosion from water and glaciers (USGS 2000).

Geology

Although the Sierra Nevada and Cascade Range are in a single province, the two ranges have been and continue to be formed by quite different geological forces and processes (USGS 2004d). The Sierra Nevada is a west-tilting 350-mile-long block of granite. The massive granite intruded the crust in Mesozoic time and was uplifted and faulted in the Tertiary during formation of the Basin and Range province to the east. The granitic rocks that underlie the fault blocks of the Sierra Nevada and the volcanic rocks of the southern Cascade Mountains join to form the eastern border of the low-lying California Trough, which contains the Central Valley. Eroded material from the Sierra Nevada has filled California's Central Valley (USGS 2003a).

The Cascade Mountains arose through the plate collisions that have enlarged the western portion of the continent in Tertiary to Quarternary time. The Cascade Mountains are comprised of a band of thousands of very small, short-lived volcanoes that have built a lava and volcanic debris platform. This mountain range contains large and geologically recent active volcanoes such as Rainier, Hood, and Shasta (USGS 2000). The few large volcanoes rise above this volcanic platform (USGS 2004e).

The northern Cascade Mountains includes rocks up to 400 millions years old. The range is a geologic mosaic made up of pieces of islands, ocean floor, and old continents that were carried along by the tectonic plates and added to the North American continent (USGS 2000). These assembled pieces were uplifted, eroded, and in some places buried again. Other pieces were forced deep into the earth to be heated and squeezed before being raised again (USGS 2000). About 35 million years ago volcanoes erupted to cover the older rocks, and large masses of molten rock invaded the older rocks from below. The volcanic arc is still active today (USGS 2000).

Pacific Border

Physiography

The Pacific Border province, also called the Pacific Uplands, consists of several mountain ranges along the Pacific Coast. These ranges are separated from the Cascade-Sierra Nevada province by troughs. The Pacific Border Province includes the Puget Trough, Olympic Mountains, Oregon Coast Range, Klamath Mountains, California Trough, California Coast Ranges, and Los Angeles Ranges (Figure 3-1) (USGS 2003a).

The Olympic Mountains in Washington are the northernmost of the coast ranges. The northwest-southeast trending Olympic-Wallowa Line across southern Washington is a structural zone that includes active earthquake faults (USGS 2003a).

Many volcanoes erupted throughout the region forming the Oregon Coast Range, but most individual craters are small. Among the larger volcanoes in the region is Crater Lake in southwest Oregon, which is part of the Cascade Range (USGS 2003a). The Klamath Mountains in southwestern Oregon and northwestern California include the Salmon and Trinity Mountains.

The California Trough (Central Valley, or Sacramento and San Joaquin Valleys) is a northwest-southeast trending elongate depression between the Sierra Nevada and Coast Ranges to the east and west, respectively (USGS 2003a). The valley is flat and full of material eroded from the surrounding mountains. These sediments contribute to the productive agricultural industry now in the region.

The California Coast Ranges consisting of the Diablo and Santa Lucia Ranges parallel the Pacific Coast in a complex series of ridges and valleys. The Transverse Ranges run perpendicular to the Coast Ranges north of Los Angeles.

Geology

The several mountain ranges underlain by severely folded, faulted, commonly metamorphosed marine and continental sediments form the Coastal Ranges (USGS 2002). Between 100 and 50 million years ago, subduction beneath the western edge of the North American continent resulted in the collision and buildup of belts of oceanic rock that gradually built the continental margin westward. During this subduction, magma rose up, causing the formation of chains of andesitic volcanoes at the surface and plutons of granitic magma beneath them. Plutonic rocks from this period are found in the Klamath Mountains, Sierra Nevada, Basin and Range, Mojave Desert, and Peninsular Ranges. During this time, the subducting plate was consumed beneath the North American plate and, by 100 million years ago, the subduction zone had shifted westward to the approximate position of today's Coast Ranges (Friedel, 2003).

The San Andreas transform fault system developed about 28 million years ago with the collision of the Pacific plate and the North American plate. This collision caused the subduction zone along the coast to cease, and the two plates began to slide past each other (Friedel, 2003). The topographic texture of western California is controlled by the San Andreas Fault system. Since the Tertiary, the shortening and wrinkling the crust due to this movement has created the parallel coastal northwest-southeast mountain ranges (USGS 2003a).

Lower California

Physiography

Several coastal mountain ranges underlain by severely folded, faulted, and commonly metamorphosed marine and continental sediments form the Lower California physiographic province (USGS 2002). The province is an extension of the Baja California peninsula. The province includes rolling mountain and valley terrain in southwestern California (Figure 3-1).

Geology

The Lower California province is comprised of the northern end of a granitic ridge forming the Baja California peninsula. The Lower California province is part of the Pacific plate and is sliding northward past the North American plate. These rocks are exposed on head lands at Point Loma and at La Jolla, California, with stretches of low estuaries filled with drifted sand and other deposits as in Mission Bay, California, and the enclosing sand spits there and along the Silver Strand which forms San Diego Bay California (NPS 2007).

Alaska

Physiography

In Alaska, a belt of mountains forms the South Central Alaska province, leading into the Alaska Peninsula and Aleutian Islands province.

Alaska is geologically and topographically diverse. Most of Alaska is on a large peninsula that forms the northwestern corner of the North American continent and separates the Arctic and Pacific Oceans. Large areas of high, rugged mountains in northern and southern Alaska are extensions of mountain systems in Canada. The Brooks Range in northern Alaska is the western terminus of the Rocky Mountain System. In southern Alaska, the Alaska and the Boundary Ranges, and the Talkeetna, Wrangell, Kenai-Chugach, and St. Elias Mountains are extensions of the Pacific Mountain System. The south peak of Mount McKinley in the Alaska Range is the highest point in the US with an altitude of 20,320 feet above sea level. The Aleutian Range that extends as a long peninsula southwestward from the Alaska mainland is an extension of the Alaska Range. Low mountains, plateaus, and highlands bound the high mountains and are, in turn, bounded by lowland areas (USGS 2002)

Geology

Alaska has a complex geology with a mosaic of geologic terranes (pieces of the Earth’s crust), where each terrane’s geologic history is different than that of adjacent terranes. All the terranes in Alaska represent blocks of the earth's crust that have moved large or small distances relative to each other. The movement might have been lateral movement with or without any rotation. Some of the terranes may have moved only a short distance, whereas others may have moved laterally for several hundreds of miles or rotated as much as 135 degrees. The pattern of Alaska terranes reflects the interactions of oceanic crustal plates with the North American plate. Large-scale lateral and rotational movements, rifting, and volcanic activity result from these interactions.

3.3.2 Geologic Hazards

Geologic hazards include earthquakes, volcanoes, landslides, and subsidence.

Seismic Risk. Earthquakes are the result of large masses of rock moving against each other along fractures called faults. The shaking due to earthquakes can be significant a dozen or more miles from the actual point where they occurred depending on type of earthquake and the type of rock and soils beneath a given location.

Crustal earthquakes, the most common, typically occur along faults, or breaks in the earth's crust, at shallow depths of 6 to 12 miles. Great subduction zone earthquakes occur around the world where the tectonic plates that make up the earth's surface collide. When these plates collide, one plate slides (subducts) beneath the other, where it is reabsorbed into the mantle of the earth. This dipping interface between the two plates is the site of some of the most powerful earthquakes ever recorded, often having magnitudes of eight to nine or larger. The 1964 Great Alaska (magnitude 9.2) earthquake was a subduction zone earthquake. Deeper intraplate earthquakes occur within the remains of the ocean floor that is being subducted beneath North America. The magnitude 6.8 intraplate earthquake that struck the Puget Sound area in 2001 was much less destructive than a crustal earthquake of the same magnitude would have been because of its great depth (33 miles). This type of earthquake could occur beneath much of the Northwest at depths of 25 to 37 miles (Oregon Department of Geology and Mineral Industries 2007).

The assessment of risk from earthquakes is complex and is usually expressed as zones of probability for given accelerations due to shaking. Figure 3-2 shows the peak accelerations with a 10-percent chance of being exceeded within the next 50 years for the western US.

Volcanoes. Volcanoes, like most earthquakes, are related to tectonic plate motion. Volcanoes cause a diversity of hazards to human culture, including clouds of hot gasses carrying rock and sand, blast effects, ash falls, and mud flows. However, unlike earthquakes, volcanoes generally give plenty of warning that they are awakening, although the actual moment of eruption may be a surprise (Oregon Department of Geology and Mineral Industries 2007). The presence of high geothermal heat flow is often associated with current and past volcanic activity. Volcanic risk is discussed below in terms of the location of volcanoes in the region. Figure 3-2 shows the location of volcanoes and volcanic fields within the western US.

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SOURCE: BLM 2007c

The assessment of risk from earthquakes is expressed as zones of probability for given accelerations due to shaking.

LEGEND:
Peak Ground Acceleration (g)

- 0-0.1
- >0.1-0.2
- >0.2-0.4
- >0.4-1.0

Peak Horizontal Ground Acceleration of the 11 Western States

Lands with a 10% probability of exceedance within 50 years

Figure 3-2

Landslides. Landslides are the downslope movement of rock, soil, or related debris; however, the term generally implies a quick movement. Geologists use the term "mass movement" to describe a great variety of processes such as rock fall, creep, slump, mudflow, earth flow, debris flow, and debris avalanche regardless of the time scale. In most mass movement, water plays a pivotal role by assisting in the decomposition and loosening of rock, lubricating rock and soil surfaces to enhance the beginning of movement, adding weight to an incipient landslide, and imparting buoyancy to the individual particles.

Mass movements can be triggered by other natural geologic disasters or human activity. Volcanic eruptions and earthquakes can initiate earth movement on a grand scale. Lahars, debris flows made up of volcanic ash and water, are often the major hazard experienced in a volcanic episode. Although earthquakes can initiate debris flows, a major cause of mass movements is continuous rains that saturate soils. Mass movements are also frequently the direct consequence of human activity. Seemingly insignificant modifications of surface flow and drainage may induce mass movements (Oregon Department of Geology and Mineral Industries 2007). Areas at risk for mass movements include areas with steep slopes and areas with slighter slopes and unstable soils (Figure 3-3).

Subsidence. Subsidence is the slow, downward sinking of the land surface. It can occur naturally in areas that are tectonically active such as volcanic regions and fault zones. Subsidence can also occur in areas where sedimentary basins are filled with unconsolidated sands, silts, clays and gravels. Subsidence can also occur as a result of the extraction of subsurface fluids, including groundwater, hydrocarbons, and geothermal fluids. In these cases, a reduction in reservoir pore pressure reduces the support within the reservoir rock itself and for the rock overlying the reservoir, resulting in a copaction of the reservoir rock potentially leading to a slow, downward deformation of the land surface. Figure 3-8 shows the areas in the western US with major unconsolidated aquifers where pumping of groundwater could result in subsidence. In Alaska, subsidence is associated with soils rich in organic carbon when they are drained for agriculture or other purposes. Microbial decomposition, under drained conditions, readily converts the organic carbon to carbon dioxide gas and water causing a reduction in soil volume (Kagel et al. 2007).

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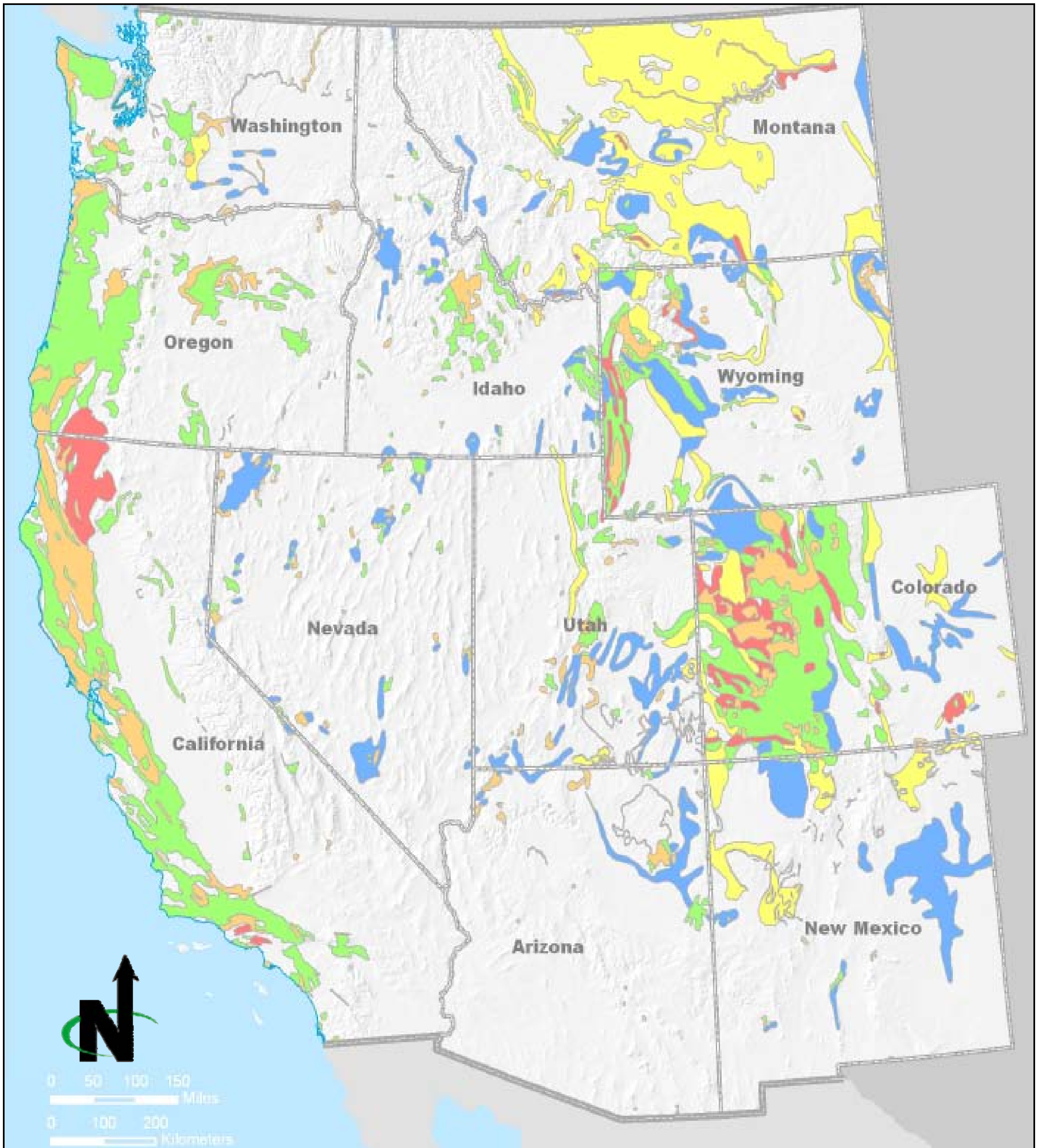

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SOURCE: BLM 2007c

Areas at risk for mass movements include areas with steep slopes and areas with slighter slopes and unstable soils.

LEGEND:

Landslide Potential

- High Incidence and High Susceptibility
- High Incidence
- Moderate Incidence
- High Susceptibility
- Moderate Susceptibility

Landslide Hazard Potential of the 11 Western States

Figure 3-3

3.4 ENERGY AND MINERAL RESOURCES

Public and NFS lands are managed for recreation, timber harvesting, livestock grazing, oil and gas production, mining, wilderness protection and other purposes (US DOE and BLM 2007). In this section, energy and mineral resources are discussed, along with their association with geothermal resources.

On federal lands, mineral resources are governed by the General Mining Law of 1872, as amended; those portions of the Federal Land Policy and Management Act of 1976, as amended (FLPMA) that affect the General Mining Law; and the Surface Resources Act of 1955 and The Mining and Minerals Policy Act of 1970. Oil, Gas leasing is guided by the Energy Policy Act of 2005. Geothermal leasing is guided by the Geothermal Steam Act of 1970 (30 USC 1004), as amended by the Energy Policy Act of 2005.

The BLM manages Oil and Gas leases under Title 43 CFR part 3100, exploration under part 3150. Geothermal leasing is managed under Part 3200, mineral materials under 3600 regulations, mining claims for locatable minerals under 3800 regulations and solid leasable minerals other than coal or oil shale under Part 3500. The FS manages oil and gas operations on NFS lands under 36 CFR subpart E. Mineral leasing operations are guided by Forest Service Manual 2820 and mineral prospecting, including geophysical activities is guided by Forest service manual 2860. Locatable minerals and surface management regulations fall under 36 CFR 228 Subpart A and Forest Service Manual 2810. Mineral materials are regulated under 36 CFR 228 Subpart C and Forest Service Manual 2850.

Wind, solar, and biomass are considered renewable energy resources, along with geothermal energy resources. These resources all have different requirements related to economic development. However, some issues are common to all, including distance to existing power transmission facilities and compatibility with existing federal land use.

3.4.1 Solar Energy Resources

Solar energy is a renewable energy resource that has excellent potential for generating electricity in a large part of the western US. Installation of solar energy facilities on public and NFS lands requires a right-of-way permit instead of a lease. There are two basic types of solar energy installations that produce electrical power: photovoltaics systems and concentrating solar power. These can be combined with natural gas or other fossil fueled power systems to form hybrid systems.

Photovoltaic Systems

Photovoltaic systems use semiconductor materials similar to those used in computer chips to capture the energy in sunlight and convert it directly into electricity. Photovoltaic cells are connected into an array. The size of the array depends on the amount of sunlight and the needs of the customer. Large photovoltaic electrical generating systems have not generally been used for commercial utility applications due to the high upfront cost. Most photovoltaic applications are small, use little or no land, and have minimal or no environmental impact because electricity created is generally used on site or as part of an existing authorized use. They generally provide power to individual homes and small buildings. They are also found in rural areas on communication towers, water pumps, and road and traffic signs.

Concentrating Solar Power Systems

Concentrating solar power plants are generally large systems that use mirrors to focus sunlight to create high temperatures. The high temperatures generated by the focused sunlight are used to generate electricity either by a heat engine causing gas to expand moving a piston or a conventional power cycle using boiling water to create steam that turns a turbine.

There are currently three different types of centralized concentrating solar power systems: parabolic trough, solar "power tower," and solar dish. These systems require relatively flat land with slopes not exceeding three percent to accommodate the solar collectors. The area of land required depends on the type of plant, but is about five acres per produced megawatt. It is anticipated that a commercial scale concentrating solar power facility may be in the range of 100 megawatts or larger and will require in excess of 500 acres.

To work effectively, the solar installations require consistent levels of sunlight (solar insolation). Solar insolation is a measurement that has become increasingly more accurate in evaluating specific sites for solar energy installations. Solar insolation is the amount of sunlight hitting an area on the surface of the earth over a specific period of time. The higher the exposure of sun measured on an annual basis, the more electrical power that can be produced. Solar energy resources are classified based on the amount of solar radiation that contacts the ground surface in a specified area. Solar radiation is measured in units of watt-hours per square meter per day. The amount of solar energy resource available at a specific location varies with the latitude of that location, the season, and the time of day.

Solar energy resource maps were prepared by the US Department of Energy, National Renewable Energy Laboratory. In addition to varying by latitude, season, and time of day, the amount of solar radiation available at known occurrences of solar energy resources is dependent on the type of collector used. The two basic designs of solar collectors are flat-plate collectors and solar concentrators.

Flat-Plate Collectors

The flat-plate collector is a fixed panel containing photovoltaic cells or solar water heaters. The flat-plate panels collect sunlight and convert it to electricity or heat. The flat panel is installed where no obstructions will block sunlight from reaching the panel. A flat-plate collector generally receives the most sun when it is tilted towards the south at an angle equal to the latitude of the location.

Solar Concentrators

The solar concentrator is a flat panel of photovoltaic cells or a concave arrangement of mirrors that concentrate sunlight onto a collector. The concentrator is attached to a motor-driven tracking mechanism. It is installed where no obstructions will block sunlight from reaching the concentrator, and uses the tracking mechanism to follow the sun as it crosses the sky each day. The tracking mechanism adjusts for seasonal variations in the Sun's azimuth and allows the solar concentrator to collect the maximum amount of direct sunlight. The flat-plate collector is more effective at collecting solar radiation than the solar concentrator.

Data concerning solar resources are collected for both concentrating solar power and photovoltaic systems. The US Department of Energy, National Renewable Energy Laboratory has developed a national solar resource assessment for the US at a resolution of approximately 25 by 25 miles. These data are updated periodically.

For photovoltaic systems, data for flat-plate collectors were used. This is typical for a photovoltaic panel oriented due south at an angle from horizontal equal to the latitude of the collector's location. Figure 3-4 shows the photovoltaic resources for the western US.

The concentrating solar power analysis used direct normal data. These data are pertinent to concentrating systems that track the sun throughout the day, such as trough collectors or dishes. Figure 3-5 shows the concentrating solar power resources in the western US.

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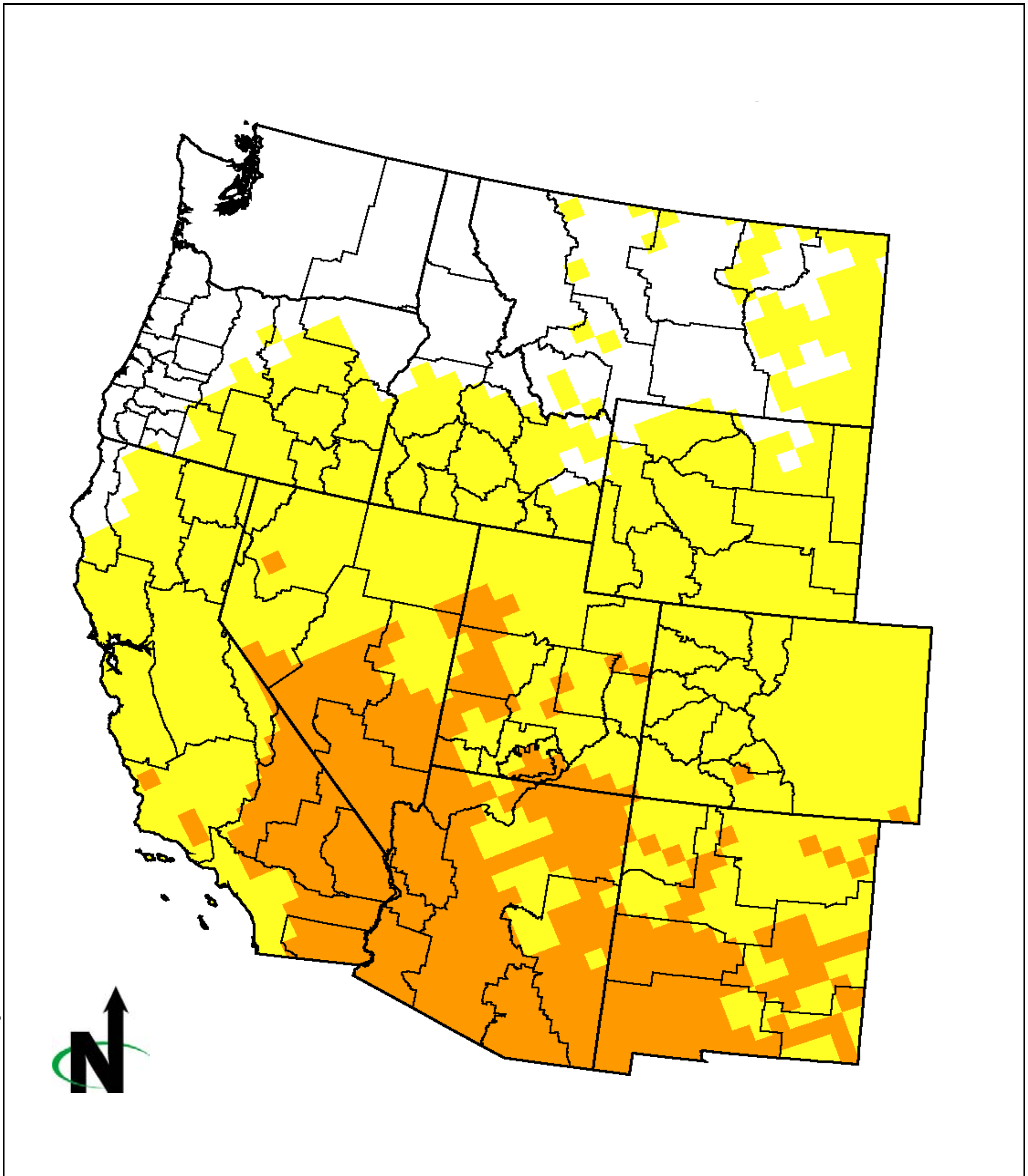

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Source: BLM 2003c

The flat-plate collector is a fixed panel containing photovoltaic cells or solar water heaters. Solar resources are available for flat plate collectors through the 11 western states, but are highest in the southwest.

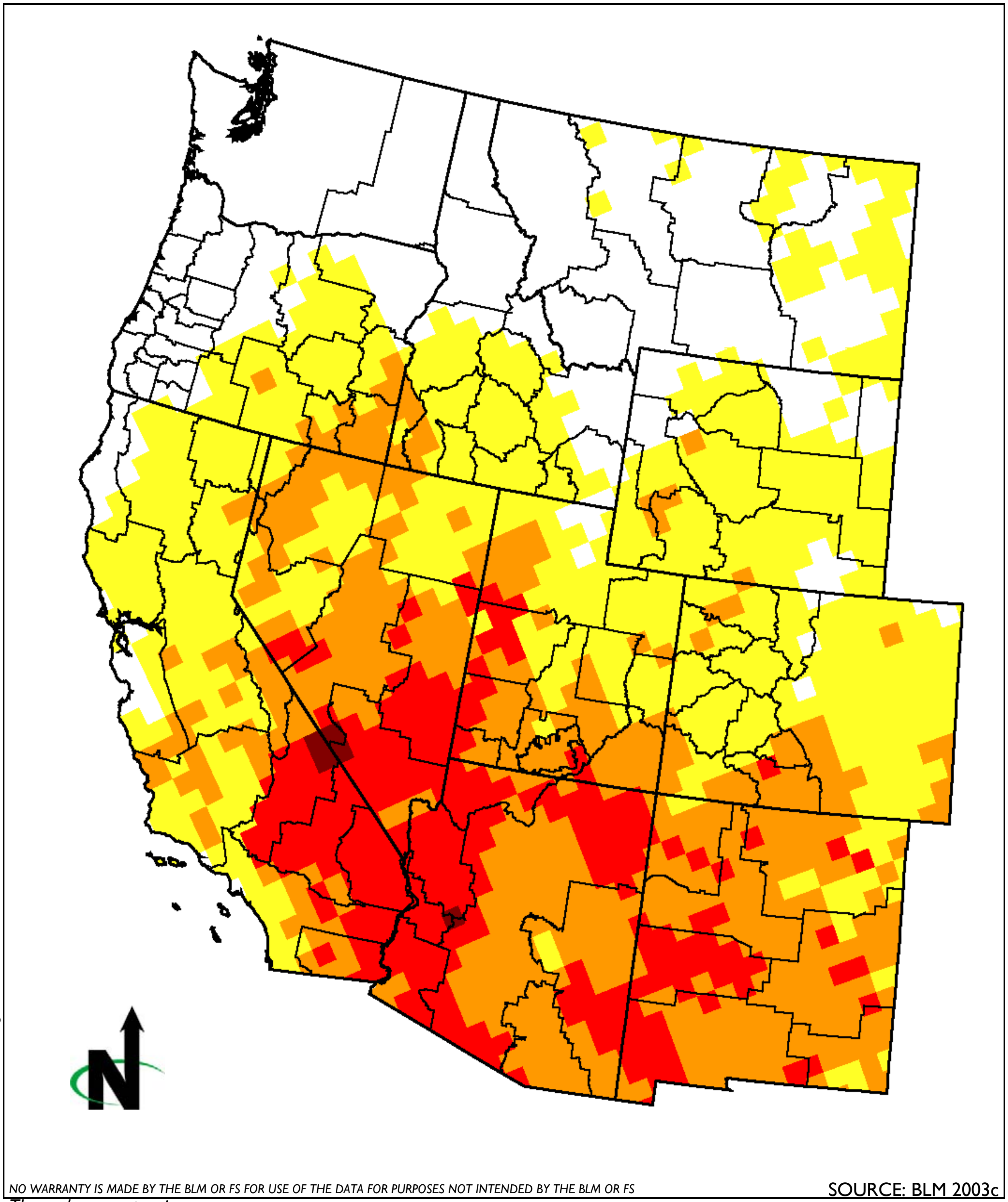
LEGEND:

Photovoltaic
Solar resources
kWh/m²/day

5
6

Yearly Average Solar Energy Resources available for flat-plate photovoltaic systems

Figure 3-4



These data are pertinent to concentrating systems that track the sun throughout the day, such as trough collectors or dishes. Solar resources are available for flat plate collectors through the 11 western states, but are highest in the southwest.

LEGEND:
Concentrating Solar Resource kWh/m²/day

- 5
- 6
- 7
- 8

Yearly Average Solar Energy Resources Available for Concentrating Solar Power Systems

Figure 3-5

3.4.2 Wind Resources

Wind energy is a renewable energy resource that has excellent potential for generating electricity. The BLM Wind Energy Programmatic EIS (BLM 2005a) has determined which areas on public lands have high, medium, or low potential for wind energy development based on the typical wind speed measured at a location. The wind power classification used in the EIS had seven wind classes based on the wind power density at a height of 164 feet (50 meters), measured in watts per square meter (Table 3-6).

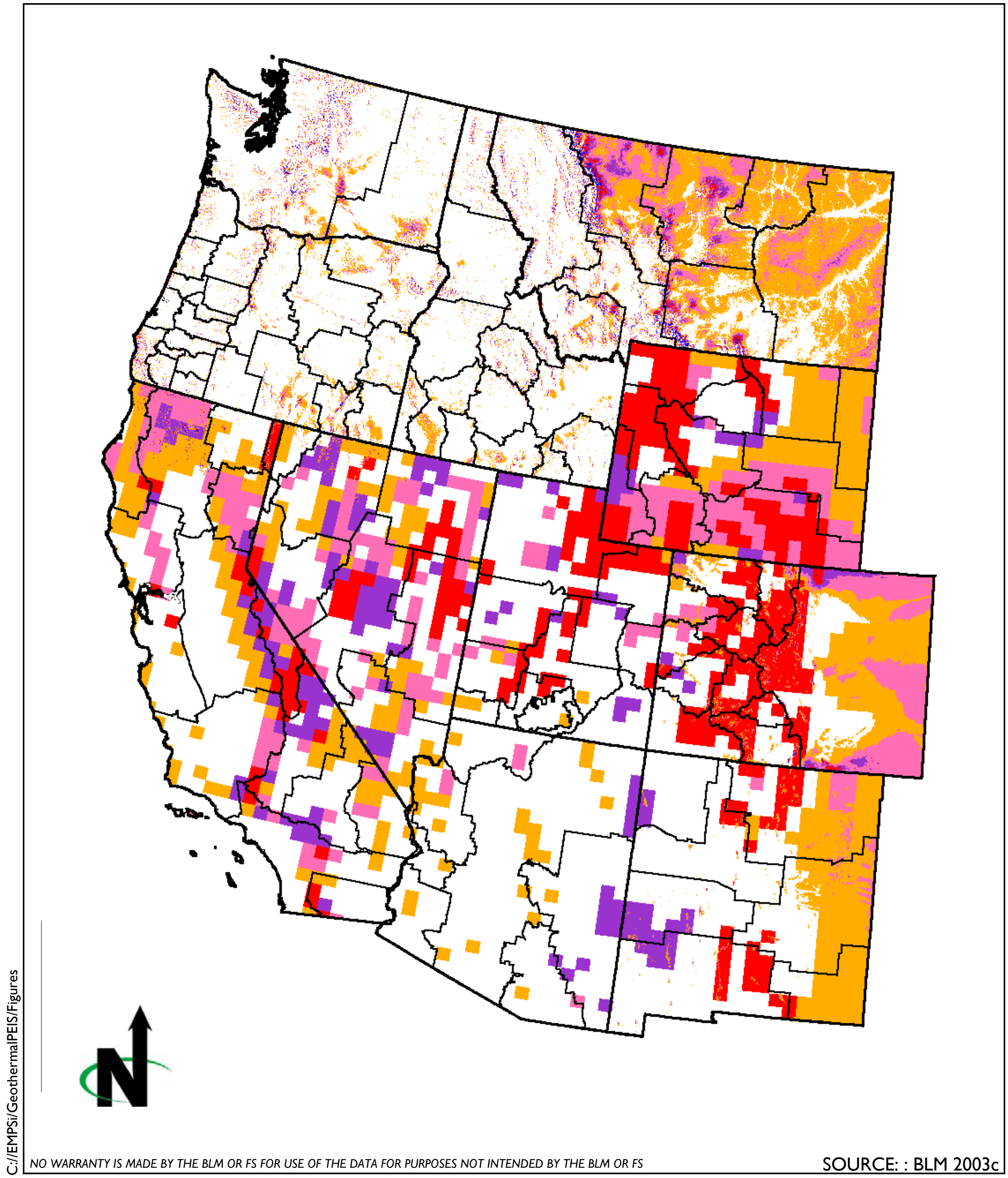
Table 3-6
Wind Power Classification/Energy Development Potential

Wind Power Class	Energy Development Potential	Wind Power Density: Watts per square meter at 164 feet (50 meters) above Ground Level	Wind Speed[a]: Miles per hour at 164 feet (50 meters) above Ground Level
1	Low	0 – 200	0.0 – 12.5
2	Low	200 – 300	12.5 – 14.3
3	Medium	300 – 400	14.3 – 15.7
4	High	400 – 500	15.7 – 16.8
5	High	500 – 600	16.8 – 17.9
6	High	600 – 700	17.9 – 19.7
7	High	>800	>19.7

[a] Mean wind speed is estimated by assuming a sea level elevation and a Weibull distribution of wind speeds with a shape factor (k) of 2.0. The actual mean wind speed may differ from the estimated values shown here by as much as 20 percent, depending on the actual wind speed distribution (or Weibull k value) and elevation above sea level.
Source: BLM 2003c

Wind power is considered economic for large turbines (commercial utilities scale) at Class 3 and higher, although a small noncommercial turbine can be used at Class 1. Figure 3-6 shows public lands and FS lands wind resources greater than Class 3.

Installation of wind energy facilities on public lands and FS lands requires a right-of-way permit instead of a lease. Rental costs may be calculated by tower installation and/or permitted acreage.



Wind power is considered economic for large turbines (commercial utilities scale) at Class 3 and higher. This map contains high (.4-1km) and low (25 km) resolution wind resource assessments.

LEGEND:

Wind Resource Power Class

- 3
- 4
- 5
- 6
- 7

Public Land and FS Wind Energy Resources

Wind Resource Power Class ≥ 3

Figure 3-6

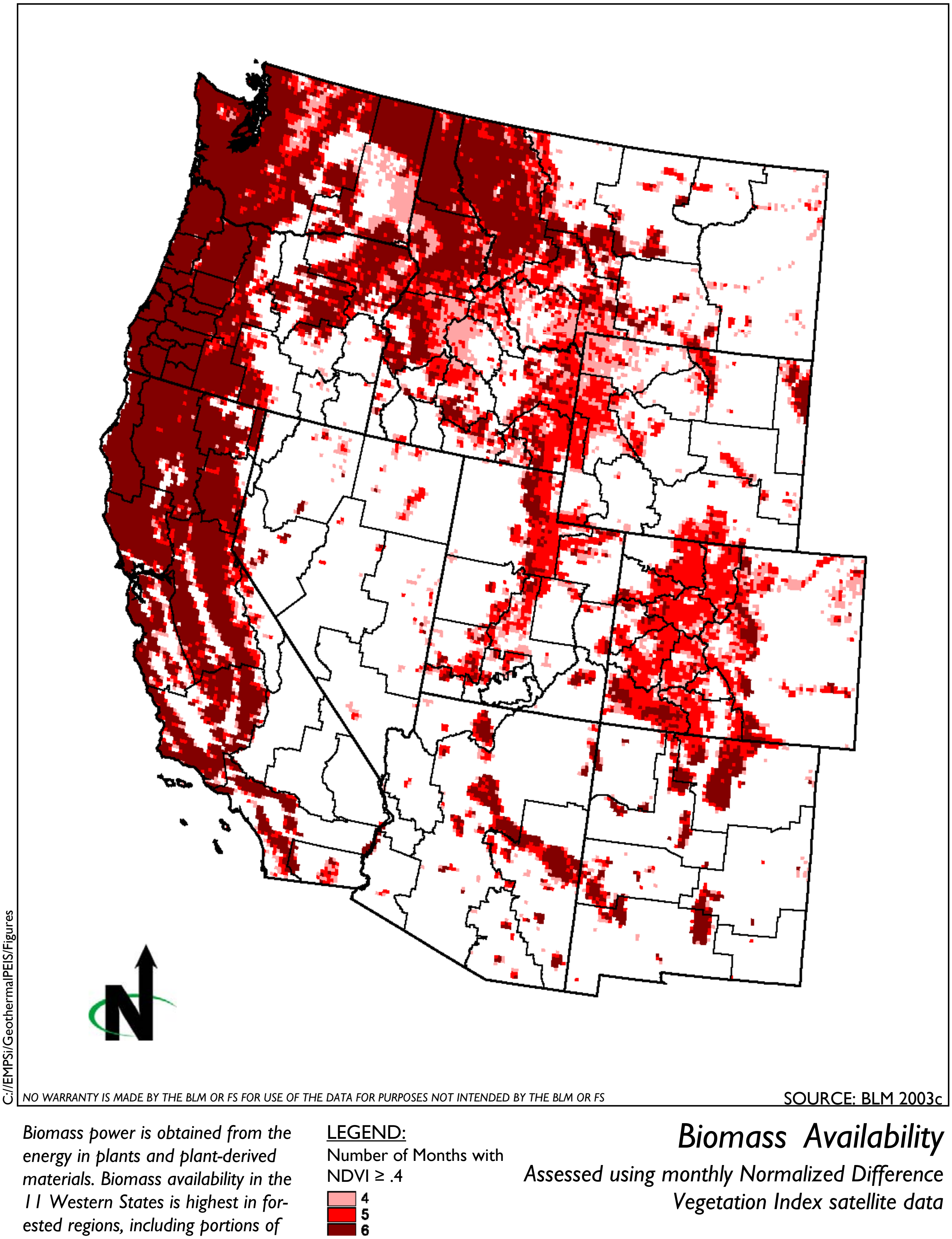
3.4.3 Biomass

Biomass power is power obtained from the energy in plants and plant-derived materials, such as food crops, grassy and woody plants, residues from agriculture or forestry, and the organic component of municipal and industrial wastes. Biomass can be used for direct heating (such as burning wood in a fireplace or wood stove), for generating electricity, or can be converted directly into liquid fuels to meet transportation energy needs (US DOI 2007).

Electricity generated from biomass is also called biopower. Biopower facilities use many different technologies; the most common is burning of wood or other biomass feed stocks to produce steam, which then is used to drive turbines and produce electricity. Some generators use a mix of biomass and fossil fuels to generate electricity, while others burn methane, a product of the natural decay of organic materials. In the US, the pulp and paper industries are major producers of biopower using residues from paper production to produce electricity for industrial plant use (US DOI 2007).

Wood has been used for energy longer than any other biomass source and remains the largest biomass energy resource. The largest source of energy from wood is pulping liquor or "black liquor," a waste product from processes of the pulp, paper, and paperboard industry. Biomass energy can also be derived from waste and from alcohol fuels. Biofuels are liquid fuels produced from plants. The two most common types of biofuels are ethanol and biodiesel. Ethanol is made by fermenting any biomass high in carbohydrates. The majority of ethanol produced in the US is made from corn. Biodiesel is made by processing vegetable oil, animal fat, or recycled cooking grease with alcohol or other chemicals. It can be used as an additive (typically 20 percent) or in its pure form as a renewable alternative fuel for diesel engines (US DOI 2007).

The availability of biomass materials was assessed using the monthly Normalized Difference Vegetation Index computed from the National Aeronautics and Space Administration’s Advanced Very High Resolution Radiometer Land Pathfinder satellite program. The Normalized Difference Vegetation Index satellite data have a resolution of five by five miles. Figure 3-7 shows the availability of biomass on public and NFS lands in the Western US.



Biomass power is obtained from the energy in plants and plant-derived materials. Biomass availability in the 11 Western States is highest in forested regions, including portions of California and the Pacific Northwest.

Biomass Availability

Assessed using monthly Normalized Difference Vegetation Index satellite data

Figure 3-7

3.4.4 Energy Minerals

Coal

Coal deposits can be found in all 12 project area western states; however, large deposits are only found within Alaska, Arizona, Colorado, Montana, New Mexico, Utah, and Wyoming (National Mining Association 2007). Together with North and South Dakota, the project area provides 45 percent of the nation's total production. The federal government is by far the largest owner of the nation's coal beds. In the west, the federal government owns 60 percent of the coal and indirectly controls another 20 percent. Coal companies must lease the land from the federal government in order to mine this coal (National Mining Association 2007).

The northern Rocky Mountain region and the Northern Great Plains of Wyoming, Montana, and North Dakota contain vast amounts of strippable coal. This region includes the 14 largest coal mines in the US, each having production of over 10 million short tons. More than 25 percent of US coal production is from 25 mines developing the Wyodak-Anderson, Anderson-Dietz, and Rosebud coal beds or zones in the Powder River Basin. These coals are relatively clean, containing less sulfur and ash than coals produced from other regions in the continuous US (USGS 1996).

Oil, Gas and Geothermal

The Northern Alaska physiographic province accounts for almost half of the oil and more than half of the undiscovered conventional gas assessed on onshore federal lands. Oil and gas resources extracted in Alaska are predominantly from the North Slope. As of 2005, Alaska accounted for 17 percent of the crude oil discovered in the US (BLM 2007c). Significant oil reserves are located throughout the Colorado Plateau. The Powder River Basin and the Wyoming Thrust Belt provinces of the Rocky Mountains and Northern Great Plains regions have the second-largest concentrations (behind Alaska) of undiscovered conventional oil and gas, respectively, assessed on federal lands (BLM 2007c). In California, oil and natural gas extraction is predominant in the San Joaquin, Ventura/Santa Barbara, Los Angeles, and Santa Maria regions. There are no significant oil, natural gas, or coal resources within the coastal areas and mountains of Washington and Oregon, in Nevada, or in Utah. There are limited oil and gas reserves in southern Arizona and southwest New Mexico (BLM 2007c).

BLM and FS consider geothermal resources to be a fluid mineral resource along with oil and natural gas. Therefore, while land closures or restrictions to fluid leasable minerals are primarily meant for oil and gas exploration and development, they apply to geothermal exploration and development as well.

Oil and gas drilling and development share other aspects with geothermal resources. Much of the data on geothermal resources comes from oil and gas well drilling. Also, there is consideration of using oil and gas infrastructure to enhance geothermal resources and vice versa (Western Governors' Association 2006).

The cost of drilling to develop geothermal resources is often the most decisive factor in determining the economic viability of proposed geothermal power plants. Yet, the thousands of oil and gas wells that are typically drilled to even greater depths (accessing even hotter zones) have scarcely been considered for use in geothermal systems. This potential applies to the deep sedimentary basins of the western US (Western Governors' Association 2006).

Many oil fields are nearing the end of the reserves that can be extracted economically. Higher oil prices and new technologies, such as enhanced oil recovery techniques and drilling microholes with less expensive rigs, can significantly increase the percentage of oil recovered profitably. The cost of electricity to operate oil fields is also an important factor in determining the economic life of those fields. Measures to reduce electrical costs, like utilizing renewable resources (wind, solar, and geothermal), can also increase the amount of profitable reserves (Western Governors' Association 2006).

Ideas being discussed in the industry include converting nearly-depleted oil and gas fields into geothermal assets using several proven technologies in unique combination. Initially, solar energy is transferred as heat to aging oil and gas reservoirs in a pattern designed to increase the recovery of remaining oil and gas, at the same time building up the heat content of the reservoir. Ultimately, the banked solar energy would be extracted using naturally occurring brines to drive geothermal power plants and local heating systems (Western Governors' Association 2006)

3.4.5 Non-Energy Minerals

Metallic Minerals

Major copper deposits are located throughout the project area, except for California and Oregon. United States copper production largely comes from deposits in southern Arizona, southern New Mexico, and Utah. Currently, most of the copper production in the US is derived from large, relatively low-grade hydrothermal mineral deposits that formed beneath composite volcanoes. Important, undeveloped hydrothermal copper deposits are hosted by sedimentary rocks in Montana; these deposits are also enriched in silver. Copper often occurs with other metals including cobalt and the platinum group elements: palladium, platinum, rhodium, ruthenium, iridium, and osmium. Major copper-cobalt deposits occur in central Idaho, and a major copper-nickel-platinum group elements deposit is located in Montana. The US ranks first in world production of molybdenum and has a large proportion of the world reserve base. Generally, molybdenum is produced as a byproduct of mining copper and, in particular, porphyry copper deposits. Therefore, the major deposits occur in essentially the same locations as copper, described above (Zientek and Orris 2005).

About 10 percent of total gold discovered in the world is in the US. Over 80 percent of the gold produced in the US in 2002 came from Nevada mines. These mines also produced approximately 30 percent of the US output of silver. Most of the major gold deposits are concentrated in Nevada, northern California, and southern Arizona. Significant deposits also occur throughout Alaska, Colorado, Idaho, Montana, New Mexico, Oregon, and Washington (Zientek and Orris 2005).

About 21 percent of total world silver discovered is in the US. More than two-thirds of the world's silver resources are associated with copper, lead, and zinc deposits. The remainder is associated with hydrothermal gold deposits. Over 40 percent of the significant and major deposits are in Nevada; significant deposits also occur in Alaska, Arizona, California, Colorado, Idaho, Montana, New Mexico, Oregon, Utah, and Washington (Zientek and Orris 2005).

Major lead and zinc deposits, sometimes with other metals, are located in Colorado and Utah, with some others in Alaska, Arizona, Nevada, Montana, Idaho, and Washington. Molybdenum deposits (Zientek and Orris, 2005).

3.4.6 Nonmetallic (Industrial) Minerals

The nonmetallic minerals include barite, garnet, bentonite, kaolinite, phosphates, diatomite, borax, gypsum, and potash. Most of the barite mined in the US comes from bedded barite deposits in Nevada. 95 percent of the world's high-quality abrasive-grade garnet, is found in the large North Creek, New York, deposit. Concentrations of garnet in Idaho and Montana are, however, great enough to form a placer garnet deposits than can be economically developed (Zientek and Orris 2005).

Bentonite is a rock consisting of clay minerals. Almost half of the world production of bentonites is from the US. Major sodium bentonite deposits are found in two districts in the western US: the Hardin district (Montana and Wyoming) and the Black Hills district (Montana, Wyoming, and South Dakota). Kaolin is a term for a group of clays that might best be described as kaolinite-bearing clays. Kaolin deposits are located in Utah, northern Nevada, and southern California. Major phosphorite deposits in the US are related to zones of oceanic upwelling that took place along the western coast of North America in the Permian (forming the western phosphate field in Wyoming, Idaho, Montana, and Utah). There is also a major phosphate deposit in northern Alaska. Diatomite is a sedimentary rock consisting chiefly of the fossilized, silica-rich skeletons of single-celled aquatic plants called diatoms. The largest production of high-purity diatomite comes from the extensive deposits near Lompoc, California. Numerous other deposits occur throughout the US, although most productive deposits are found in the west (Zientek and Orris 2005).

Borates are extracted primarily in California. The majority of boron production in California is from Kern County, California, with the balance from San Bernardino and Inyo Counties. Gypsum is mined primarily in southern Nevada, southern California, and central New Mexico. Potash refers to a group of water-soluble salts that contain the element potassium. Of the five sedimentary basins that host major potash deposits in the US, two are within the western US: the Gulf Coast Basin that covers parts of Alabama, Arkansas, Florida, Mississippi, eastern Texas, Louisiana, and extends into Mexico; and the Permian Basin that covers parts of Colorado, Kansas, New Mexico, Oklahoma, and western Texas. Most domestic production is from evaporite deposits in the Permian Basin near Carlsbad, New Mexico (Zientek and Orris 2005).

Aggregates are sand, gravel, stone, pumice, pumicite, cinders, and ordinary clay used for construction and decorative purposes. Each state in the western US develops its own aggregate resources areas, as transportation is a great part of the cost of the materials. Industrial minerals such as aggregate, limestone, and shale dominate mineral extraction throughout most of California. In southeastern California, southern Arizona, and southern New Mexico, the minerals predominantly extracted include construction aggregate including construction sand, gravel, and crushed stone. Raw, nonfuel minerals extracted throughout Nevada, southern Idaho, southwestern Oregon, and most of Utah include aggregate, gypsum, limestone, trona, shale, and stone. Construction aggregate (including crushed stone and common clay) is the dominant mineral extracted throughout Colorado (BLM 2007c).

3.5 PALEONTOLOGICAL RESOURCES

This analysis involved a review of scientific literature concerning the types and significance of paleontological resources known to occur on public and NFS lands in the project area (Baars 2000, BLM 2007d, Cooper et al. 1990, FS 1996, King 1977, Murphey and Daitch 2007, Peterson et al. 1973, and Reed et al. 2005). It also included a review of paleontological resource sections (if present) of 101 BLM RMPs for 62 BLM field offices in 12 states, which resulted in paleontological resources information for approximately half of the BLM field offices in the project area (Appendix E). Because of the large size of the project area, combined with the inherently discontinuous geographic distribution of geothermal resources, a list of potentially affected geologic units (formations and members thereof) was not compiled for this programmatic analysis. However, as appropriate, paleontological resources described in this section are discussed with reference to the Potential Fossil Yield Classification (PFYC) that was recently revised and adopted as policy by the BLM (BLM IM 2008-009) (Appendix E). The basis for the BLM's resource management classification scheme was the similar PFYC produced and still employed by the FS (FS 1996). Paleontological sensitivity maps based on the PFYC are available for only two of the affected states: Colorado and Utah. The BLM's preparation of additional PFYC maps for the other 10 states is ongoing.

The project area is known to contain some of the most fossiliferous sedimentary rock units in North America. Because of their fossil content, these rocks and correlative strata elsewhere in western North America have been the focus of continuous scientific interest and inquiry for approximately the last 135 years. The rich fossil record of the area ranges in age from the Archean Eon to the Upper Pleistocene Epoch, and represents a temporally discontinuous span of approximately 2.9 billion years. Collectively, these units (formations and members thereof) have produced an estimate of millions of scientifically significant fossil specimens from thousands of fossil localities.

Paleontologic and associated geologic fieldwork in the project area has produced an unprecedented amount of scientific data that continues to be used to study a wide variety of aspects of Phanerozoic biotas, including aspects of their evolution, biostratigraphy, paleobiogeography, paleoenvironments, taphonomy, and paleoecology. Fossils include highly diverse assemblages of vertebrates (fishes, amphibians, reptiles, birds, and mammals), invertebrates (mollusks, arthropods, insects, and many others), and plants (including algae), and include the holotypes of many presently recognized fossil taxa. Housed in museums throughout the US, fossils of western North America have been the subject of thousands of published scientific studies. Much knowledge of Paleozoic through Pleistocene climates, environments, and biotas of North America comes from studies of project area fossils and geology. In addition, individual fossils may also provide information on variation in the species and thereby provide insight on its evolution.

3.5.1 Definition and Significance of Paleontological Resources

Paleontology is a multidisciplinary science that combines elements of geology, biology, chemistry, and physics in an effort to understand the history of life on earth. Paleontological resources, or fossils, are the remains, imprints, or traces of once-living organisms preserved in rocks, sediments, and caves. These include mineralized, partially mineralized, or unmineralized bones and teeth, soft tissues, shells, wood, leaf impressions, footprints, burrows, and microscopic remains. The fossil record is the only evidence that life on earth has existed for more than 3.6 billion years. Fossils are considered nonrenewable resources because the organisms they represent no longer exist. Thus, once destroyed, a fossil can never be replaced. Fossils are important scientific and educational resources because they are used to:

- Study the phylogenetic relationships among extinct organisms, as well as their relationships to modern groups;
- Elucidate the taphonomic, behavioral, temporal, and diagenetic pathways responsible for fossil preservation, including the biases inherent in the fossil record;
- Reconstruct ancient environments, climate change, and paleoecological relationships;
- Provide a measure of relative geologic dating, which forms the basis for biochronology and biostratigraphy, and which is an independent and corroborating line of evidence for isotopic dating;
- Study the geographic distribution of organisms and tectonic movements of land masses and ocean basins through time;
- Study patterns and processes of evolution, extinction, and speciation; and
- Identify past and potential future human-caused impacts on global environments and climates (Murphey and Daitch 2007).

3.5.2 Paleontology and Geologic History of the Western United States

The geologic record of the history of earth, along with the associated history of life contained within the fossil record, has been subdivided into a series of eons, eras, periods, and epochs that define and encompass the entire 3.8 billion years of earth's history based on the geologic record. The following is a description of the paleontological and geologic history of western North America, including Alaska, with an emphasis on the project area. The discussion is divided into time periods from oldest to youngest, beginning with the Archean Eon of the Precambrian, from which the oldest known fossils in western North America date. It includes descriptions of the types of fossils present in western North America and their general provenance and scientific importance, major associated events in the history of life, the pale geography of western North America, and paleoenvironmental conditions of this region through time.

3.5.3 Archean and Proterozoic Eons of the Precambrian

Most of the history of life occurred during the vast stretch of time known as the Precambrian, which includes the older Archean Eon (3.8 to 2.5 billion years ago) and the younger Proterozoic Eon (2.5 billion to 543 million years ago). The oldest known fossils from western North America are of Archean age and consist of stromatolites that are approximately 2.8 billion years old. Stromatolites are lithified organosedimentary structures in which laminations are formed by communities of cyanobacteria trapping and binding sediments. Locally, these fossils form spectacular reefs in places such as the Medicine Bow Mountains in Wyoming. Stromatolites are also known from much younger rocks although modern forms are rare. Other fossils of Precambrian age in western North America consist of palynomorphs and algal filaments and globules known from 800 million year old sedimentary rocks of the Uinta Mountains in Utah. Precambrian (Archean and Proterozoic) life forms consisted of a diversity of unicellular prokaryotic (cells lacking nuclei) bacteria. The oldest known eukaryotic cells (cells with nuclei) have been reported from the Neoproterzoic of Australia, and are approximately 900 million years old. The close of the Precambrian is marked by the first appearance of multicellular life forms in the late Neoproterozoic. Known as the Ediacaran fauna, fossils of these enigmatic organisms include imprints of soft bodied forms and the first exoskeletons of marine invertebrates. Fossils of the Ediacaran fauna are now known from a number of localities around the world, although North American localities are known only from the east coast.

Fossils of Precambrian age are rare in western North America, although this is in large part because noncrystalline unmetamorphosed sedimentary rocks of this age are uncommon. The antiquity of Precambrian-age fossils and the information they provide about the origins of life makes them highly significant scientifically. In western North America, sedimentary rocks of this age occur in parts of Montana, Wyoming, Utah and Arizona, and are generally recommended for designation as PFYC Class 3 (Moderate or Unknown: Fossiliferous sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence; or sedimentary units of unknown fossil potential) (Appendix E).

3.5.4 Paleoezoic Era

The Paleozoic Era lasted from approximately 543 to approximately 242 million years ago. It is subdivided into seven periods including, from oldest to youngest, the Cambrian, Ordovician, Silurian, Devonian, Mississippian, Pennsylvanian, and Permian.

A major adaptive radiation took place during the Cambrian Period that resulted in the evolution of most of the known phyla (broad groupings of organisms) as well as other phyla that have since become extinct. This geologically rapid appearance of diverse multicellular life is referred to as the Cambrian explosion, and is best documented in the fauna of the Burgess Shale (Middle Cambrian-age

Stephan Formation) of British Columbia. One of the most widespread and diverse groups of animals, the trilobites, first appeared at the beginning of the Cambrian, diversifying and evolving throughout most of the Paleozoic. Although the Cambrian fossil record is dominated by trilobites, other groups that evolved during this period include brachiopods, mollusks, echinoderms, porifera (sponges), and cnidaria (corals), as well as numerous extinct phyla.

At the beginning of the Cambrian Period, the landmass that would later become North America (referred to as Laurentia) was situated directly over the equator. East of Laurentia were several small continental masses that would eventually become Siberia, northern Europe, and Kazakhstan. Further east was the super-continent Gondwana, which included the combined land masses of South America, Africa, Antarctica, Australia, and China. During the Cambrian, the North American landmass was oriented at 90 degrees from its present orientation so that the paleoequator was on a line roughly from Texas to Hudson Bay, and the Canadian Shield formed highlands surrounded by ocean. Western North America was largely under water during this time, and was located north of the Canadian Shield between approximately 5 and 20 degrees north latitude. Sediments of Cambrian age in western North America include quartz-rich sandstone and limestone deposited in a shallow carbonate sea and muddy shale that was deposited in deeper waters. Cambrian-aged rocks are exposed in the Grand Canyon area, in parts of Colorado Utah and Idaho, in north-central Nevada, and in parts of California and the Pacific Northwest.

By the end of the early Ordovician Period, the uninterrupted sequence of carbonate deposition associated with the shallow seas of the Cambrian ended, and a period of craton-wide erosion lasted throughout much of the rest of the Ordovician. By the late Ordovician, the Laurentide landmass (that would later form North America) was centered just south of the paleoequator and was again almost completely covered with a shallow carbonate sea. This Late Ordovician marine transgression resulted in an explosive radiation and diversification of marine organisms shells of calcium carbonate. This fauna was dominated by brachiopods but also included crinoids, echinoderms, gastropods, trilobites, nautiloid cephalopods, and graptolites.

During the middle Ordovician, the earliest radiation of vertebrates was underway (modern vertebrates include animals with backbones including fishes, amphibians, reptiles, birds, and mammals). These early vertebrates are preserved in sandstone beds of the Harding Formation on public lands in south-central Colorado, and consist of scales and teeth of primitive jawless fishes called agnathans, a group that first appeared during the latest Cambrian.

During the middle Ordovician and early Silurian periods, a range of mountains was uplifted in the northern part of the Appalachian region of the eastern US, and shallow carbonate seas covered much of the cratonic interior of North America. Coral reefs were common and resulted in widespread deposition of limestone and dolomite. Silurian shallow-marine fossil faunas are dominated by articulate brachiopods, but also include bryozoans, cephalopods, crinoids, corals, ostracods, conodonts, and eurypterids (sea scorpions). The Silurian Period also saw the initial evolution of land plants. Rocks of Silurian age are more common in the eastern US but occur locally in the west with relatively widespread exposures in Nevada.

By the early Devonian Period, Laurentia had coalesced with Baltica (a slightly smaller landmass east of Laurentia that would later become western Europe), and the two were closely associated with the southern supercontinent Gondwana. Land that would later become western North America was located just south of the paleoequator, and was mostly covered by a shallow carbonate sea. A narrow chain of island mountains (the Antler Mountains) was present from what is today southern Nevada to northern Idaho. The area northwest of these mountains (the area that would later become the pacific coast of North America) was occupied by a deep, muddy ocean. Devonian seas contained reef systems and marine faunas similar to those of the Ordovician, and major radiations of both ammonoids and conodonts occurred during this time. A major diversification of vertebrate life was occurring simultaneously, with five classes of fish appearing by the Early Devonian (often referred to as the "age of fish"). This radiation of fishes included the agnathans (jawless fish that are represented today by the hagfish and lamprey), the Acanthodii (all extinct), the armored Placoderms (all extinct), the Chondrichthyes (sharks, skates and rays), and the Osteichthyes (bony fishes). The first land vertebrates (tetrapods) evolved during the Late Devonian and consisted of amphibians. This heralded what would be a dramatic evolutionary radiation and diversification of land vertebrates during the Carboniferous. The land plants that first appeared in the Silurian diversified and became abundant by the Early Devonian. Devonian-age rocks in western North America are present from New Mexico, Arizona, and Nevada north into Canada. Important fossil bearing rocks of Devonian age rocks in western North America are located in Nevada, Idaho, and southwestern Canada.

By the early Mississippian Period, Laurentia remained in an equatorial position and most of western North America remained under a shallow carbonate sea. The Appalachian Mountains extended from Georgia north into Labrador (their uplift having been a result of a continental collision with Gondwana along the southern margin of Laurentia), but land in western North America was limited to a small arc of highlands that developed from continued uplift of the Antler Mountains. These highlands consisted of a narrow swath of land that extended from southern California to northern Idaho. East of the Antler Highlands, a broad shallow carbonate sea extended east to the Great Lakes region, while west of the highlands were deeper ocean waters. The Antler Highlands provided a source material for thick deposits of Mississippian aged shale in Utah and deposits of sandstone and conglomerate in northern and eastern Nevada. Mississippian marine deposits now form extensive limestone deposits in

Montana, Wyoming, Utah, eastern Idaho, and Colorado, and comprise the red cliff limestone walls of Arizona's Grand Canyon. Fossil crinoids are abundant in Mississippian limestone, and the Mississippian Period has been referred to as the "age of crinoids." Other characteristic fossils include bryozoans, brachiopods, echinoderms, and foraminifera. Land plants of the Mississippian include forms that are transitional between those of the Silurian and Pennsylvanian Periods.

During the Pennsylvanian Period, all of the land masses on the globe were in the process of coalescing into a single massive supercontinent called Pangaea. The Appalachian mountain range and associated lowlands in the south and east provided source material for broad areas of sedimentation to the west. In the middle Pennsylvanian, the Ouachita Mountains formed in a narrow swath from central Texas to Louisiana. The end of uplift that had earlier produced the Antler Mountains coincided with the beginning of the Colorado Orogeny in the area of Colorado, Utah, and New Mexico. These new mountains, together with the Antler Mountains, formed isolated islands in a shallow sandy and muddy sea that covered most of the interior of North America, with a deep ocean on the western margin of the part of Pangaea that would later become North America. An island arc that extended from the location of northern California to southern Alaska, along what is now the Pacific coast, was the only land west of the Antler Mountains. Subsidence in areas adjacent to the ancestral Rocky Mountains resulted in thick sequences of Pennsylvanian-aged nonmarine shale, sandstone, and conglomerate in Colorado, and temporally equivalent sequences of marine limestone and sandstone in Colorado and Utah. Pennsylvanian-age rocks form extensive deposits throughout much of the central and western US from eastern Kansas to western Nevada and north to Montana.

The Pennsylvanian Period is associated with two major events in the history of life. The first was the development of vast cycads and tree fern forests including those along the western flank and adjacent lowlands of the Appalachian Mountains, resulting in a dramatic diversification of plant life that would ultimately be preserved as the rich coal beds of eastern and central North America. The second event was the evolution of reptiles during the lower Pennsylvanian which are first known from Nova Scotia. A large inland sea still covered much of the western US, and fossils from western North America are predominantly marine in origin.

The Permian Period marks the end of predominantly marine environments over much of North America, and is associated with both the regression of continental seas and the gradual emergence of the North American continent. By the late Permian, the Appalachian and Ouachita mountains had joined to form a single extensive range that extended from western Texas to Labrador roughly along a line that would become the Gulf and Atlantic coasts. However, western North America remained largely under shallow and deep seas. The volcanic island arc that had developed during the Pennsylvanian now extended from Baja California north to Alaska. Vast barrier reefs formed in the vicinity of west Texas. A broad phosphorite basin formed in an area that extended from northern Nevada to British Columbia, and these phosphate deposits are exposed today in Wyoming, Utah, Montana, and Idaho. Extensive deposits of Permian-age red sandstone and mudstone beds in the Rocky Mountain region indicates deposition on coastal mudflats and alluvial floodplains.

During the Permian Period, reptiles diversified and increased in abundance, assuming an ecological role as the dominant land vertebrates. The mammal-like reptiles, or therapsids, which included the ancestors of true mammals, were diversifying. The most dramatic paleontological event of the Permian was the massive global terminal Permian extinction event, the largest documented extinction event in the entire Phanerozoic. As many as 90 percent of all marine invertebrate families, including such dominant forms as the trilobites, went extinct by the end of the Permian. Large numbers of terrestrial animal and plant species also went extinct.

Sedimentary rocks of Cambrian, Ordovician, and Silurian age contain diverse fossil invertebrate assemblages but few vertebrate fossils. These are generally recommended for designation as PFYC Class 3 (Moderate or Unknown) (Appendix E). Sedimentary rocks of Devonian through Permian age have the potential to produce well-preserved and scientifically significant vertebrate fossils, although vertebrate occurrences are typically localized and uncommon. Locally abundant and well-preserved marine invertebrate fossils are also known. Sedimentary rocks of these time periods could range in sensitivity from PFYC Class 3 through 5 (Appendix E).

3.5.5 Mesozoic Era

The Mesozoic Era lasted from approximately 242 to 65.5 million years ago. It is subdivided from oldest to youngest into the Triassic, Jurassic, and Cretaceous periods. Generally, the Mesozoic Era is characterized by the evolution, diversification, and eventual extinction of dinosaurs, as well as the evolution of mammals, birds, and flowering plants.

During the Early Triassic, deposition of red beds similar to those of the Permian took place in much of North America. The North American continent remained near the equator in a similar orientation as during the Permian, and much of western North America was covered by seas. A sandy and muddy alluvial plain extended far west and north from the Ouachita-Appalachian Mountains, and a shallow muddy and sea with numerous barrier islands at its eastern margin extended from southern New Mexico north to Alaska. The Sonoma Orogeny resulted in a series of highlands and mountains that extended from northern Baja California to northern British Columbia. The Sonoma Mountains were surrounded by deep muddy waters and the extensive western volcanic arc remained to the west of the Sonoma range. Late Triassic-age sedimentary rocks of marine origin are present in southern Alaska and in the Brooks Range to the north.

The picturesque red and variegated beds of the Triassic-aged Moenkopi and Chinle formations are exposed throughout much of western North America, particularly on the Colorado Plateau. These rocks units are known to preserve a variety of vertebrate fossils such as terrestrial amphibians and reptiles, including primitive dinosaurs. They also yield locally abundant fossil plants and a variety of fossil trackways. The oldest mammal fossils are also known from the Triassic. Marine life during the Triassic was associated with a dramatic diversification of ammonoid cephalopods. These fossils are abundant in the marine fossil record and are biostratigraphically important. Triassic reefs were formed by new and more complex forms of reef building organisms that evolved in the wake of the late Permian extinctions. By the end of the Triassic Period, reptiles were not only abundant in terrestrial ecosystems, but had also evolved into aquatic forms such as plesiosaurs and ichthyosaurs.

By the beginning of the Jurassic, most of the North American continent was above water, and plate tectonics had caused a northward migration of the continent. The Appalachian Mountains and low-relief highlands extended west to roughly the present location of the Mississippi River. West of these highlands were alluvial lowlands and coastal plains that extended all the way west to Nevada. The Westernmost portion of North America including all of Alaska remained under waters of the Sundance Sea. Early Jurassic rocks in the western US typically consist of thick sequences of cross-bedded sandstone. The eolian sand dune deposits of the Navajo Sandstone are the best known example. In the westernmost portion of North America, Jurassic-age rocks consist of dark shale, bedded chert, graywacke, and conglomerate. By late Jurassic time, the volcanic island arc present along the western margin of North America had collided with the continent (the Nevadan Orogeny). Continued subduction along the western margin of the continent resulted in the deposition of Jurassic and Cretaceous aged marine rocks in the California Coast Ranges and to the east in the Great Valley of California. The Nevadan Orogeny marked the beginning of a protracted series of mountain building events known as the Cordilleran Orogeny that would continue throughout the remainder of the Mesozoic and into the Cenozoic. During the late Jurassic, the Sundance Sea east of the Cordilleran highlands experienced a major regression that coincided with deposition of the terrestrial highly fossiliferous Morrison Formation over a vast area of the western US.

The Morrison Formation contains abundant and diverse assemblages of fossil vertebrates, invertebrates, and plants, and characterizes the broad diversification of dinosaurs during the Jurassic. It also preserves smaller vertebrates including frogs, salamanders, lizards, crocodiles, and primitive fossil mammals, and is one of the most heavily researched formations in the world by paleontologists. During the Jurassic, vertebrates evolved the ability to fly as represented by the earliest birds and the reptilian pterosaurs. Marine reptiles such as plesiosaurs and ichthyosaurs were also more abundant than during the Triassic. Marine life during the Jurassic was dominated by mollusks and ammonoids with abundant crinoids and echinoids.

By the beginning of Cretaceous time, the rifting and break up of the supercontinent Pangaea was well underway. By the mid-Cretaceous, the North American continent had moved northward and was centered at near 40 degrees north latitude, with Alaska situated near the North Pole. Continued oceanic plate subduction along the western margin of the US during the Cretaceous resulted in a range of mountains and highlands that extended from Mexico to Alaska. A trangression of marine waters from both the Gulf of Mexico and the Arctic during early Cretaceous time resulted in the development of the broad (900-mile-wide) Cretaceous Interior Seaway that extended from Utah east to Ohio, and completely separated the western highlands from those to the east. By late Cretaceous time, the primarily marine sediments of the early and middle Cretaceous that covered much of the western interior were giving way to estuarine and coastal plain sediments as the seaway retreated. By latest Cretaceous time, the Laramide Orogeny, which resulted in the uplift of the Rocky Mountains, was underway. Terrestrial and marine rocks of Cretaceous-age are common throughout western North America.

Cretaceous marine deposits contain abundant and diverse invertebrate fossils typically including ammonoids, bivalves, gastropods, echinoderms, corals, and bryozoans. Marine vertebrates were also common and include giant fishes, mosasaurs (marine lizards), plesiosaurs, pliosaurs, and turtles as large as 13 feet long. Terrestrial vertebrate faunas were dominated by abundant and diverse dinosaurs such as *Triceratops*, *and Tyrannosaurus*. Pterosaurs attained wingspans of up to 30 feet. Birds diversified during the Cretaceous, as did mammals, although many mammals remained small and shrew-like in appearance. Plant evolution during the Cretaceous was marked by the appearance of angiosperms (flowering plants) that evolved during the early Cretaceous and coevolved with insects throughout this period, ultimately dominating plant communities by the end of the Cretaceous. The end of the Cretaceous Period is marked by the well known Cretaceous-Tertiary boundary event that resulted in the mass extinction of many animal and plant species 65.5 million years ago, and is widely accepted to have been caused largely by an asteroid impact. Included in the extinction were both marine and terrestrial organisms including dinosaurs (with the exception of birds), mosasaurs, plesiosaurs, pterosaurs, and many species of plants and invertebrates.

Sedimentary rocks of Triassic, Jurassic, and Cretaceous age may contain diverse and locally abundant assemblages of scientifically significant fossil vertebrates, invertebrates, and plants. These rock units generally could meet PFYC Class designations of 3, 4, or 5 (Appendix E).

3.5.6 Cenozoic Era

The Cenozoic Era lasted from 65.5 million years ago to the present and includes two periods, the Tertiary and Quaternary. The Tertiary Period is divided into the Paleogene and Neogene periods. The Paleogene includes the Paleocene, Eocene, and Oligocene epochs, and the Neogene includes the Miocene and Pliocene epochs. The Quaternary Period is divided into the Pleistocene and the Holocene. The Cenozoic Era is associated with the diversification of mammals following the extinction of nonavian dinosaurs and their dominance of terrestrial faunas, as well as the development of modern ecosystems and climatic regimes during the Quaternary. The youngest fossils are generally considered by paleontologists to date to the end of the Pleistocene Epoch, approximately 10,000 years ago. Accordingly, fossils are not considered to be present in sedimentary deposits of Holocene age, which contain only the unfossilized remains of modern species of animals and plants.

By the beginning of the Cenozoic Era, the North American continent was nearing its present geographic orientation and location. The Laramide Orogeny of the Late Cretaceous and early Cenozoic marked the final stages of the Cordilleran Orogeny. The Cordilleran Orogeny, which began during the Jurassic, had progressed eastward throughout the Mesozoic, resulting in the final uplift of the central Rocky Mountains by the end of the Cretaceous. This period also marked the end of marine environments within the western interior of North America. During the Laramide Orogeny, intermontane basins developed as a result of down-warping between Rocky Mountain uplifts, and surrounding highlands provided source material for thick sequences of Tertiary-aged fluvial and lacustrine sediments that accumulated in these basins. Also deposited in these basins were the organic remains of animals and plants that would eventually become the rich fossil record that documents the ecosystems of the early and middle part of the Cenozoic. In addition to extensive deposits of limestone, shale, mudstone, siltstone, and sandstone, significant amounts of volcaniclastic sediment were deposited throughout western North America during the Cenozoic. The west coast of North America is the leading edge of the North America continent and, as such, is tectonically more dynamic, resulting in a highly complex distribution of formations. A confusing array of deep marine, shallow marine, and nonmarine sediments of varying ages have been thrust, accreted, and shifted along the Pacific coast of North America. As a result, a wide variety of Cenozoic-aged sedimentary rocks with abundant fossils of both terrestrial and marine organisms are exposed along the Pacific Coast and in adjacent areas. Cooling and drying of global climates began during the Eocene and continued throughout the Oligocene, Miocene, Pliocene, and into the Pleistocene ice ages. The cool wet climates of the Pleistocene resulted in massive glacial expansion in the northern portion of the North American continent and in mountainous areas, while a vast lake system developed in the Midwest. Glacial till, eolian sand, alluvium, and colluvium are common types of Pleistocene-aged sedimentary deposits that occur in western North America.

The fossil record of the Cenozoic Era is extremely well preserved in rock units in western North America. Following the extinction of the dinosaurs at the end of the Cretaceous, mammals rapidly radiated and diversified into their respective modern groups, as well as several archaic groups that went extinct during the early part of the Tertiary. Eocene forests were inhabited by a host of mammals including insectivores, primates, marsupials, bats, rodents, small and large carnivores, tapirs, horses, rhinos, and many others. By the late Eocene, all the modern orders of mammals had evolved and were represented by species that were ancestral to the modern forms known today. As climates cooled, the tropical and subtropical forests of the Paleocene and early Eocene gave way to more open woodlands, and tropical species of animals including some types of fishes, turtles, alligators, crocodiles, and primate mammals, retreated south or went extinct in North America. Continued global cooling and drying led to the evolution of grassland ecosystems during the Miocene. General adaptive strategies for mammalian groups at this time included an increase in body size, the ability to digest grasses, and a trend towards greater cursoriality (skeletal modifications to become more effective runners). The diverse perissodactyls (odd-toed ungulates such as horses, rhinos, tapirs, brontotheres, and chalichotheres) of the early Tertiary steadily diminished in diversity as the artiodactyls (even-toed ungulates such as oreodonts, deer, bison, pronghorn, sheep, and goats) diversified throughout the Cenozoic. The first appearance of many modern mammal species can be traced back to the Pleistocene. However, many animals that were adapted to cooler climates went extinct as temperatures warmed at the end of the Pleistocene, although warmer temperatures were not necessarily the cause of the late Pleistocene extinctions. Extinct Pleistocene mammals include mammoth and mastodon, cave bear, North American lion, North American cheetah, saber tooth tiger, ground sloth, dire wolf, giant beaver, and the giant *Bison antiquus*.

Sedimentary rocks of Tertiary age are known to contain diverse and locally abundant assemblages of scientifically significant fossil vertebrates, invertebrates, and plants. As a result, these rock units are generally recommended for designation as PFYC Class designations of 3, 4, or 5 (Appendix E). Quaternary (Pleistocene) vertebrate, invertebrate, and plant fossils are typically uncommon and poorly preserved in most surficial sediments, although localized rich accumulations are known in western North America from cave deposits and other unusual settings such as tar pits. Pleistocene-age surficial deposits are generally recommended for designation as PFYC Class 2 (Low: Sedimentary geologic units that are not likely to contain vertebrate fossils or scientifically significant nonvertebrate fossils) (Appendix E) unless prior local discoveries warrant a higher class designation.

3.5.7 Review of BLM Resource Management Plans

A review of BLM RMPs for field offices in the project area was conducted to determine if paleontological resources had been previously addressed and, if so, if the paleontological sensitivity of the geologic units within each BLM field office could be estimated given the information provided. If sufficient information was available, an attempt was made to equate the information provided to the PFYC recently adopted as policy by the BLM (BLM Instruction Memorandum 2008-009) (BLM 2007d) (Appendix E). There was insufficient information to estimate PFYC subclasses a or b for PFYC Classes 3 through 5.

A total of 101 RMPs were reviewed from 62 BLM field offices in the 12-state project area (Appendix E) (Table 3-7). Resource Management Plans were not available for 57 of the BLM field offices within the project area. In cases where paleontological resources were not addressed, estimates of paleontological sensitivity could not be made. Of the 101 RMPs reviewed, 32 contained sufficient information on fossil occurrences or geologic formations to estimate sensitivity and tentatively assign PFYC classes for the geologic units within the field office (Table 3-7).

Table 3-7
Project Area BLM RMPs Reviewed & Tentative PFYC Classes

State	RMPs Reviewed	RMPs with Sufficient Information to Tentatively Assign PFYC Classes
Alaska	4	3
Arizona	5	4
California	11	1
Colorado	10	3
Idaho	13	4
Montana	10	8
New Mexico	9	3
Nevada	6	1
Oregon	4	0
Utah	13	5
Washington	3	0
Wyoming	13	0
Total	**101**	**32**

3.6 SOIL RESOURCES

Soil resources are categorized into *land resource units* that consider significant geographic differences in soils, climate, water resources, or land use. Land resource units are generally several thousand acres in size and typically coextensive with state general soil map units. Geographically associated land resource units are grouped into *major land resource areas*, which are in turn grouped into *land resource regions*. These large areas are used in statewide agricultural planning, as well as interstate, regional, and national planning (USDA Natural Resource Conservation Service 2006).

Soils in the project area are diverse and range from the arid, saline soils of the southwest, to the clayey glaciated soils of Montana, to the cold, wet permafrost soils of Alaska. Soils are the result of complex interactions between parent material (geology), climate, topography, organisms, and time. Soils are classified by the degree of development into distinct layers or horizons and their prevailing physical and chemical properties. Similar soil types are grouped together into soil orders based on defining characteristics, such as organic matter and clay content, amount of mineral weathering, water and temperature regimes, or other characteristics that give soil unique properties, such as the presence of volcanic ash or permafrost (BLM 2007c).

3.6.1 Description of Soil Orders and Classifications

Soil Orders

Alfisols can be found throughout the mountains of western Montana and Wyoming and in central Colorado and California. They are characterized by subsurface clay accumulations and nutrient-enriched subsoil. Alfisols commonly have a mixed vegetative cover and are productive for most crops, including commercial timber (BLM 2007c).

Andisols occur in Washington, Oregon, Idaho and along the Cascades in Northern California. In Alaska they are found in the southwest part of the Alaskan Peninsula and in the Aleutians (University of Idaho 2007). They are soils that have formed on volcanic ash deposits. They have high amounts of volcanic glass and organic matter, giving them a light, fluffy texture (BLM 2007c). As a group, Andisols tend to be highly productive soils (USDA Natural Resource Conservation Service 2006).

Aridisols occur across wide parts of the western US in Nevada, Arizona, New Mexico, central Wyoming, southern Idaho, and southern California. These soils are characterized by an extreme water deficiency. They are light colored, low in organic matter, and may have subsurface accumulations of soluble materials, such as calcium carbonate, silica, gypsum, soluble salts, and exchangeable sodium. Vegetation on these soils includes scattered desert shrubs and short bunchgrasses, which are important resources for livestock. Aridisols are generally not very productive without irrigation and may be prone to salinity buildup. Surface mineral deposits often form physical crusts that impede water infiltration (BLM 2007c).

Entisols occur extensively in eastern Montana and western Colorado, Wyoming, Utah, and central California. They are young, weakly developed mineral soils that lack significant profile development (soil horizons). They are often found in lower-elevation, arid, and semiarid environments supporting desert shrub and sagebrush communities. Entisols can include recent alluvium, sands, soils on steep slopes, and shallow soils. Soil productivity ranges from very low in soils forming in shifting sand or on steep rocky slopes to very high in certain soils formed in recent alluvium. Productivity is often limited by shallow soil depth, low water-holding capacity, or inadequate available moisture. However, these soils support rangeland vegetation and may support trees in areas of higher precipitation (BLM 2007c).

Gelisols occur almost exclusively in the tundra regions of Alaska. They are underlain by permanently frozen ground (permafrost). Some gelisols in wet environments have developed large accumulations of organic matter, particularly in areas of bogs and wetlands. Soil-forming processes take place very slowly above the permafrost in the active layer that thaws seasonally. These soils support tundra vegetation of lichens, grasses, and low shrubs that grow during brief summers. Plant productivity is low and limited by the northern latitudes' extremely short growing season, low levels of solar radiation, and poor water drainage. Bare rock is also common in Alaska, comprising nearly 8 million acres (BLM 2007c).

Histosols occur in limited areas in northern Washington, Central Colorado, and southwestern Alaska (University of Idaho 2007). They are organic soils that typically form in lowland areas with poor water drainage. Areas containing these soils are commonly called bogs, moors, peats, or mucks. The soils form in decomposed plant remains that accumulate in water, forest litter, or moss faster than they decay (USDA, Natural Resources Conservation Service 2006). While not extensive, Histosols are often associated with riparian or wetland resources and can be very important locally (BLM 2007c).

Inceptisols are found in northern Idaho and parts of Washington, Oregon, and Montana, as well as southwestern Alaska. They are generally young mineral soils but have had more time to develop profile characteristics than Entisols. They principally occur in very cool to warm, humid, and subhumid regions and in most physiographic conditions, and often support coniferous and deciduous forests, as well as rangeland vegetation. They may form in resistant rock or thin volcanic ash on steep mountain slopes or depressions, on top of mountain peaks, or next to rivers. Productivity is varied and may be high where moisture is adequate (BLM 2007c).

Mollisols in the project area are found in northern Montana, eastern Oregon, Washington, and Idaho, where they have developed from basalt and loess parent materials. These soils typically support grasslands and are mineral soils with thick, dark-colored surface horizons rich in organic matter from the dense root systems of prairie grasses. They are one of the most productive soils on public lands, and their high organic matter content helps reduce the risk of groundwater contamination by herbicides. Mollisols extend from upland areas to the prairie grasslands, where they are most abundant. Mollisols support a variety of plant communities, including grasslands, chaparral-mountain shrub, and forests. Since they have developed primarily under grassland vegetation, mollisols have been used extensively for livestock grazing (BLM 2007c).

Spodosols occur in northern Washington, central Colorado, and central Alaska (University of Idaho 2007). They are highly leached, acid**ic** soils that typically form on sandy soils under cold, humid conditions at high elevations (BLM 2007c). They are characterized by a subsurface accumulation of humus that is complexed with aluminum and iron (University of Idaho 2007). These soils commonly occur in areas of coarse textured deposits under coniferous forests of humid regions. They tend to be acid and infertile and require additions of lime in order to be productive agriculturally (USDA, Natural Resources Conservation Service 2006).

Ultisols occur in southwestern Washington, western Oregon and in the coastal mountains and the Cascade Range in California. They are formed through fairly intense weathering and leaching processes that result in a clay enriched subsoil. They are found primarily in humid temperate forest areas, typically on older, stable landscapes. These soils are low in nutrients, but, with soil additives, they are productive for row crops (University of Idaho 2007, USDA, Natural Resources Conservation Service 2006).

Vertisols occur in central and eastern Montana, and sporadically throughout the Western U.S. They have large amounts of expanding clay that causes them to have high shrinking and swelling characteristics (BLM 2007c). When wet, these soils swell, transmitting water very slowly, therefore, they have undergone little leaching and tend to be high in natural fertility (USDA, Natural Resources Conservation Service 2006).

Further soil classification includes suborder, great group, subgroup, family, and series. These classifications are based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Where further classification is discussed below, appropriate definitions have been included in the glossary.

Farmlands

The purpose of the Farmland Protection Policy Act (Public Law 97-98, 7 USC 4201) is to minimize the extent to which federal programs contribute to the unnecessary and irreversible conversion of farmland to nonagricultural uses, and to assure that federal programs are administered in a manner that, to the extent practicable, will be compatible with state and local government and private programs and policies to protect farmland. The term "farmland" includes all land defined as follows:

- Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oilseed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, and without intolerable soil erosion, as determined by the Secretary of Agriculture. Prime farmland includes land that possesses the above characteristics but is being used currently to produce livestock and timber. It does not include land already in or committed to urban development or water storage;
- Unique farmland is land other than prime farmland that is used for production of specific high-value food and fiber crops, as determined by the Secretary of Agriculture. It has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality or high yields of specific crops when treated and managed according to acceptable farming methods; and
- Farmland, other than prime or unique farmland, that is of statewide or local importance for the production of food, feed, fiber, forage, or oilseed crops, as determined by the appropriate state or unit of local government agency or agencies, and that the Secretary of Agriculture determines should be considered as farmland for the purposes of the Farmland Protection Policy Act.

Cropland of statewide importance is land, in addition to prime farmlands, that is of statewide importance for the production of food, feed, fiber, forage and oilseed crops. Criteria for defining and delineating this land are to be determined by the appropriate State agency or agencies. Generally, additional farmlands of statewide importance include those that are nearly prime farmland and that economically produce high yields of crops when treated and managed according to acceptable farming methods.

Prime and unique farmlands, as well as farmlands of statewide importance are discussed for specific lease sites as farmlands soils are identified and managed by local soil conservation districts. The exception is where loss of farmland soils has been identified as a regional priority.

Biological Soil Crusts

Biological soil crusts (also known as cryptogamic, microbiotic, cryptobiotic, or microphytic crusts) are commonly found in semiarid and arid environments.

They provide important functions, such as improving soil stability and reducing erosion, fixing atmospheric nitrogen, contributing nutrients to plants, and assisting with plant growth (BLM 2007c).

Crusts are composed of a highly specialized nonvascular plant community consisting of cyanobacteria, green and brown algae, mosses, and lichens, as well as liverworts, fungi, and bacteria. Biological soil crusts occupy open spaces between the sparse vegetation of the Great Basin, Colorado Plateau, Sonoran Desert, and the inner Columbia Basin, and occur in agricultural areas, native prairies, and Alaska (BLM 2007c).

Biological soil crusts can reach up to several inches in thickness and vary in terms of color, surface topography, and surficial coverage. Crusts generally cover all soil spaces not occupied by vascular plants, which may be 70 percent or more in arid regions. They are well adapted to severe growing conditions but are influenced by physical disturbances, fire, and application of herbicides. Disturbance of biological crusts results in decreased soil organism diversity, nutrients, stability, and organic matter (BLM 2007c).

Soil Erosion and Compaction

Soil erosion is a concern throughout the project area, particularly in semiarid rangelands. The quantity of soil lost by water or wind erosion is influenced by climate, topography, soil properties, vegetative cover, and land use. While erosion occurs under natural conditions, rates of soil loss may be accelerated by human activities (BLM 2007c).

Tundra lands in Alaska are susceptible to erosion if the thick vegetative mat overlying permafrost is disturbed or removed. Trails quickly turn into widely braided ruts, especially in wetlands and at stream bank crossings. The resulting gully erosion can rapidly erode substantial quantities of previously frozen soils. Erosion from ice is also a concern due to spring-breakup flood events leaving disturbed stream channels. These events cause previously stable riparian areas to form a long-lasting sequence of extensively braided channels, especially in glacial soils (BLM 2007c).

Rangelands are affected by all four types of water erosion: sheet, rill, gully, and stream bank, as well as by wind erosion. Sheet erosion is relatively uniform erosion from the entire soil surface and is therefore often difficult to observe, while rill erosion is initiated when water concentrates in small channels as it runs off the soil. Sheet and rill erosion can reduce the productivity of rangeland soils but often go unnoticed. Gully and stream bank erosion is far more visible and may account for up to 75 percent of erosion in desert ecosystems. Changes in water flow patterns in arid areas resulting from thunderstorms and fire events can increase the size and frequency of runoff events and sediment yield to local water sources. Wind erosion is most common in arid and semiarid regions where lack of soil moisture greatly reduces soil's adhesive capability (BLM 2007c).

Soil compaction occurs when moist or wet soil aggregates are pressed together and the pore space between them is reduced. Compaction changes soil structure, reduces the size and continuity of pores, and increases soil density. Wheel traffic, large animals, vehicles, and people can cause soil compaction. Compaction becomes a problem when the increased soil density limits water infiltration, increases runoff and erosion, or limits plant growth or nutrient cycling (BLM 2007c).

3.6.2 Characteristics by Land Resource Region

Northwestern Forest, Forage, and Specialty Crop Region

In the project area, this region covers 90,165 square miles in parts of Oregon (42 percent), Washington (39 percent), and California (19 percent). It is comprised of the Northern Pacific Coast Range, Foothills, and Valleys, Willamette and Puget Sound Valleys, Olympic and Cascade Mountains, Sitka Spruce Belt, Coastal Redwood Belt, Siskiyou-Trinity Area, Cascade Mountains, and Eastern Slope major land resource areas (USDA, Natural Resources Conservation Service 2006). The dominant soil orders in this region are Alfisols, Andisols, Entisols, Inceptisols, Spodosols, and Ultisols. Soils on the hilly and steep uplands are mostly Andisols and Inceptisols. These soils are shallow to very deep and are well drained. Soils on the marine and glacial outwash terraces are dominantly Andisols and Spodosols. These soils are shallow or moderately deep to cemented materials or are deep or very deep. They are poorly drained to well drained. Entisols and Inceptisols are on floodplains and estuaries. These soils are very deep and typically are very poorly drained or poorly drained. Alfisols and Ultisols are on the mountains slopes. They are moderately deep or deep and are well drained. Mollisols are in the Willamette Valley. These soils are moderately deep to very deep and typically are moderately well drained. Most of the soils formed in colluvium or residuum weathered from siltstone and sandstone, but some formed in colluvium weathered from basalt or other volcanic rocks. The soils have a mixed mineralogy (USDA, Natural Resources Conservation Service 2006).

Northwestern Wheat and Range Region

This region covers 81,255 square miles in parts of Idaho (44 percent), Washington (29 percent), and Oregon (27 percent). A very small part is in Utah. It is comprised of the Columbia Basin, Columbia Plateau, Palouse and Nez Perce Prairies, Central Rocky and Blue Mountain Foothills, Snake River Plains, Lost River Valleys and Mountains, and Eastern Idaho Plateaus major land resource areas (USDA, Natural Resources Conservation Service 2006). The dominant soil orders in the region are Mollisols and Aridisols. Other soil orders that occur in the region are Alfisols, Andisols, Entisols, and Inceptisols. Mollisols and Aridisols formed in a deep mixture of loess and ash deposits overlying the basalt flows in this region. The other soil orders formed in alluvium on terraces and floodplains or in residuum and colluvium on foothills and mountain slopes. Most of the soils are deep or very deep, well drained, and loamy (USDA, Natural Resources Conservation Service 2006).

California Subtropical Fruit, Truck, and Specialty Crop Region

This region is entirely in California and covers 62,350 square miles (USDA, Natural Resources Conservation Service 2006). It is made up of the Central California Coastal Valleys, Central California Coast Range, California Delta, Sacramento and San Joaquin Valleys, Sierra Nevada Foothills, Southern California Coastal Plain, and Southern California Mountains major land resource areas (USDA, Natural Resources Conservation Service 2006). The soils in this region are dominantly Alfisols, Entisols, Mollisols, and Vertisols. Fluvents, Orthents, and Ochrepts on floodplains and alluvial fans are the most important soils used for agricultural purposes in this region. The soils in the region dominantly have mixed or smectitic mineralogy (USDA, Natural Resources Conservation Service 2006).

Many of the soils on floodplains and low terraces in the San Joaquin River valley are affected by salts and must be skillfully managed for good crop production. The agricultural drainage water in this valley commonly has a high salt load, and the salinity in receiving streams typically increases in a downstream direction. Soil resource concerns throughout this agriculturally rich region include controlling rainfall- and irrigation-caused water erosion and maintaining the soils' organic matter content. Wind erosion is a hazard in the San Joaquin River valley and in some of the coastal valleys. Irrigation water management is a priority in this populous region, where agriculture and urban areas compete for good-quality water. Salinity and the intrusion of saltwater into aquifers are management concerns in the coastal valleys (USDA, Natural Resources Conservation Service 2006).

Western Range and Irrigated Region

This region is the largest of all the land resource regions in land area, covering 549,725 square miles in parts of Arizona (21 percent), Nevada (20 percent), California (14 percent), New Mexico (13 percent), Utah (11 percent), Wyoming (7 percent), Texas (5 percent), Oregon (4 percent), Colorado (3 percent), Idaho (2 percent), and Montana (less than 1 percent) (USDA, Natural Resources Conservation Service 2006). It includes the following major land resource areas: Klamath and Shasta Valleys and Basins; Sierra Nevada Mountains; Southern Cascade Mountains; Malheur High Plateau; Humboldt Area; Owyhee High Plateau; Carson Basin and Mountains; Fallon-Lovelock Area; Great Salt Lake Area; Central Nevada Basin and Range; Southern Nevada Basin and Range; Mojave Desert; Lower Colorado Desert; Northern Intermountain Desertic Basins; Cool Central Desertic Basins and Plateaus; Warm Central Desertic Basins and Plateaus; Colorado Plateau; Southwestern Plateaus, Mesas, and Foothills; Mogollon Transition; Arizona and New Mexico Mountains; Sonoran

Basin and Range; Southeastern Arizona Basin and Range; and Southern Desertic Basins, Plains, and Mountains (USDA, Natural Resources Conservation Service 2006). The soils in this region are dominantly Aridisols, Entisols, and Mollisols. The dominant suborders are Argids and Calcids on plains and in basins; Orthents on plains, on plateaus, and in valleys throughout the region; and Xerolls and Ustolls on mountain slopes. The soils in the region dominantly have a mixed mineralogy (USDA, Natural Resources Conservation Service 2006).

Rocky Mountain Range and Forest Region

This region covers 236,510 square miles in parts of Montana (28 percent), Colorado (20 percent), Idaho (16 percent), Wyoming (13 percent), Utah (10 percent), Oregon (5 percent), Washington (4 percent), and New Mexico (3 percent). It includes the following major land resource areas: Northern Rocky Mountains, Central Rocky Mountains, Blue and Seven Devils Mountains, Northern Rocky Mountain Valleys, Northern Rocky Mountain Foothills, Wasatch and Uinta Mountains, Southern Rocky Mountains, Southern Rocky Mountain Parks, Southern Rocky Mountain Foothills, and High Intermountain Valleys (USDA, Natural Resources Conservation Service 2006). The soils in this region are dominantly Alfisols, Entisols, Inceptisols, and Mollisols. The dominant suborders are Ustepts, Ustolls, and Xerolls in valleys and on the lower mountain slopes, and Cryalfs and Orthents on the upper mountain slopes and crests. The soils in the region dominantly have a mixed mineralogy (USDA, Natural Resources Conservation Service 2006).

Northern Great Plains Spring Wheat Region

This region covers 142,225 square miles in the northern part of Montana and most of the Dakotas. Approximately 23 percent of this region lies within the project area in northern Montana. In Montana, the major land resource areas include Brown Glaciated Plain, Northern Dark Brown Glaciated Plains, and a small amount of Rolling Soft Shale Plain (USDA, Natural Resources Conservation Service 2006). Much of this region has been topographically smoothed by continental glaciation and is blanketed by undulating till and level to gently rolling lacustrine (lake) deposits. The surficial geology in the southwestern part of the region consists mainly of residual sediments weathered from sedimentary rocks. Alluvial deposits are along drainage ways (USDA, Natural Resources Conservation Service 2006). The soils in this region are dominantly Mollisols. Ustolls and Aquolls are the dominant suborders. Ustolls are on uplands, and Aquolls are in low wet areas and along streams. Aquolls are extensive in the Red River Valley. Some of the Ustolls have a high content of sodium, and some of the Aquolls have a high content of sodium and lime. Other important soils are Orthents on the steeper slopes. The soils in the region dominantly have mixed or smectitic mineralogy (USDA, Natural Resources Conservation Service 2006).

Western Great Plains Range and Irrigated Region

In the project area, this region covers 213,945 square miles in Montana (22 percent), New Mexico (16 percent), Colorado (15 percent), Nebraska (15 percent), and Wyoming (14 percent). The relevant major land resource areas in the southeastern part of Montana, eastern quarter of Wyoming , eastern part of Colorado, and central part of New Mexico include the following: Northern Rolling High Plains, Northern Part; Pierre Shale Plains; Pierre Shale Plains, Northern Part; Black Hills Foot Slopes; Black Hills; Mixed Sandy and Silty Tableland and Badlands; Central High Plains, Northern Part; Central High Plains, Southern Part; Upper Arkansas Valley Rolling Plains; Canadian River Plains and Valleys; Upper Pecos River Valley; Central New Mexico Highlands; and Southern Desert Foothills.

The soils in this region are dominantly Entisols and Mollisols. Other notable orders are Alfisols, Aridisols, Inceptisols, and some Vertisols. The dominant suborders are Ustorthents, Torriorthents, Haplustolls, and Argiustolls. Other notable suborders are Haplargids, Haplustalfs, and Haplustepts. Most have mixed or smectitic mineralogy, but some have carbonatic mineralogy (USDA, Natural Resources Conservation Service 2006). The major soil resource concerns in this region are overgrazing and the wind erosion and water erosion that occur where the ground cover has deteriorated. The invasion of undesirable plant species is a concern on rangeland. Wind erosion, water erosion, maintenance of the content of organic matter in the soils, and soil moisture management are major resource concerns on cropland. The quality of surface water also is a concern. Sediment, nutrients, pesticides, and organic material are the major nonpoint sources of surface and ground water pollution. Control of saline seeps on rangeland and salt management on irrigated land are needed in some areas (USDA, Natural Resources Conservation Service 2006).

The Denver, Fort Collins, Greeley, Fort Morgan, Limon, and Springfield, Colorado, urban areas are part of the Central High Plains, Southern Part major land resource area. A major soil resource concern in this major land resource area is the loss of prime farmland and cropland of statewide importance through conversion to urban use. Additional concerns are wind erosion, water erosion, surface compaction, increased salinization and overall degradation of soil quality caused by tillage and irrigation practices.

Central Great Plains Winter Wheat and Range Region

This region covers 219,740 square miles in Texas, Kansas, Oklahoma, Nebraska, New Mexico, and Colorado. Approximately 7 percent of this region lies inside the project area in far eastern New Mexico and Colorado, and a very small part of southeastern Wyoming. The relevant major land resource areas in the project area include the following: Central High Tableland; Southern High Plains, Northwestern Part; Southern High Plains, Southern Part; and Southern High Plains, Southwestern Part (USDA, Natural Resources Conservation Service 2006).The soils in this region are dominantly Mollisols, but significant acreages of

Alfisols, Entisols, and Inceptisols also occur. The dominant soil suborder is Argiustolls. Other notable suborders include Haplustolls, Ustipsamments, Calciustolls, Paleustolls, and Paleustalfs. Mineralogy is dominantly mixed but is smectitic or carbonatic in some soils (USDA, Natural Resources Conservation Service 2006).

The major resource concerns on the grassland in this region are overgrazing and invasive plants and noxious weed spread. The major resource concerns on cropland are wind erosion, water erosion, maintaining soils' organic matter content, and managing soil moisture. The quality of surface water also is a concern. Sediment, nutrients, pesticides, and salinity are the major nonpoint sources of surface and ground water pollution. Control of saline seeps on rangeland and salt management on irrigated land are concerns in some areas of the region (USDA, Natural Resources Conservation Service 2006).

Southern Alaska

This region covers 95,210 square miles in the southern part of Alaska. It includes the arc of coastal lowlands and mountains along the Gulf of Alaska from the Alexander Archipelago in the southeast to Kodiak Island and the southern portion of the Alaska Peninsula in the west. It also includes the lowlands and mountains of Cook Inlet. It is made up of the Alexander Archipelago-Gulf of Alaska Coast, Kodiak Archipelago, Southern Alaska Coastal Mountains, Cook Inlet Mountains, Cook Inlet Lowlands, and Southern Alaska Peninsula Mountains major land resource areas (USDA, Natural Resources Conservation Service 2006). The soils in this region dominantly have mixed or amorphic mineralogy. Gelepts and Cryepts occur on steep mountain slopes. Cryods, Cryands, Aquands, and Cryepts are on the lower slopes, foothills, and moraines. While Spodosols and Andisols intergrade in some areas, Andisols are dominant in the areas closer to volcanic sources. These areas include the Alaska Peninsula, Kodiak Island, the southern Kenai Peninsula, Kruzof Island, and Baranof Island. The Cryepts on the younger surfaces include Eutrocryepts and Dystrocryepts. Fluvents and Aquents are dominant on flood plains and low terraces. Histosols and Histic subgroups of other orders occur throughout the region. They are on level and depressional landforms and even on the steeper slopes along the coast and in the southeast. The Histosols include Fibrists, Hemists, Saprists, and Folists (USDA, Natural Resources Conservation Service 2006).

Aleutian Alaska

This region covers 10,670 square miles and includes the southwest part of the Alaska Peninsula, the Aleutian Islands, and the Pribilof Islands. The region includes the Aleutian Islands-Western Alaska Peninsula major land resource area (USDA, Natural Resources Conservation Service 2006). The dominant soils are Andisols, primarily Cryands that formed in volcanic ash or scoria. The soils in the area have an amorphic or mixed mineralogy. Soil textures grade from coarse scoria and cinders to fine sand with increasing distance from the volcanoes. Bare rock and rubble occur on the steep slopes of volcanic cones, peaks, and high ridges. Histosols, especially Fibrists, occur in depressions and on broad valley bottoms (USDA, Natural Resources Conservation Service 2006).

Interior Alaska

This region covers 259,260 square miles and includes the vast interior of Alaska, from the south slope of the Brooks Range to the north slope of the Alaska Range. It also includes the Copper River Basin and its surrounding mountains. It is made up of the following major land resource areas: Copper River Basin, Interior Alaska Mountains, Interior Alaska Lowlands, Yukon-Kuskokwim Highlands, Interior Alaska Highlands, Yukon Flats Lowlands, Upper Kobuk and Koyukuk Hills and Valleys, and Interior Brooks Range Mountains (USDA, Natural Resources Conservation Service 2006).

This region is in the zone of discontinuous permafrost. Not all of the soils have permafrost in their profile. With a temperature near 30 degrees F (-1 degree C), the permafrost in this region is warmer than that in the Northern Alaska Region (land resource region Y). Distribution of the permafrost-affected soils is determined by landform position, particle size, and moisture content of the soils. Much of the area on the flanks of the Brooks Range and Alaska Range is covered by rock, snow, and ice. Gelisols and Inceptisols are the dominant soils. The soils in the region have a dominantly mixed mineralogy. In areas on mountain slopes, Orthels and Turbels are intermixed with Gelepts and Gelolls. In these areas, the soils that are not affected by permafrost formed in the coarser textured materials on the steeper slopes. Orthels and Turbels are intermixed with Cryepts on low hills and mountains. An even mixture of Gelisols and Inceptisols dominates the basins. The Inceptisols have a more recent history of fire than the Gelisols. Wildfires disturb the insulating organic material at the surface, lowering the permafrost layer and eliminating perched water tables from these former Gelisols. Depending on the frequency of the fires, landform position, and particle size, these Inceptisols may or may not revert back to Gelisols. Histosols are in depressions throughout the region. Organic soils include Histels with permafrost and Hemists without permafrost. Spodosols and Andisols are of limited extent in the region. Cryods are in scattered areas in some of the mountainous parts of the region. Cryands are in parts of the Yukon-Kuskokwim Highlands (USDA, Natural Resources Conservation Service 2006).

Western Alaska

This region covers 91,300 square miles in the western part of Alaska. It is near the Bering Sea from the Alaska Peninsula and Bristol Bay lowlands to the southern Seward Peninsula. The region includes the northern Bering Sea islands. It is made up of the Northern Alaska Peninsula Mountains, Bristol Bay-Northern Alaska Peninsula Lowlands, Ahklun Mountains, Yukon-Kuskokwim Coastal Plain, Northern Bering Sea Islands, and Nulato Hills-Southern Seward Peninsula Highlands major land resource areas (USDA, Natural Resources Conservation Service 2006). Gelisols, which have permafrost in their profile, occur throughout the region and comprise about 45 percent of the soil types. Orthels and Turbels are on level to sloping coastal plains and terraces as well as on foot slopes and in swales in the hills and mountains. Mollorthels and Molliturbels are typical in the limestone uplands of the northern Bering Sea islands. Histels are in most of the depressions throughout the region. Coarse textured Gelepts and Gelolls are on steep slopes in the mountainous areas. Well-drained Cryepts and Cryolls are on moraines and outwash plains. Cryands are in areas where volcanic ash and loess mantle older landforms and in areas along the flanks of cinder cones. Well-drained Cryods are in scattered areas on uplands throughout the region. Fluvents are on floodplains and levees, and Psamments are in dune areas (USDA, Natural Resources Conservation Service 2006).

Northern Alaska

This region covers 125,550 square miles in the northern part of Alaska. It includes the northern slope of the Brooks Range, the western Brooks Range, and the northern and western Seward Peninsula. The region is made up of the Seward Peninsula Highlands, Northern Seward Peninsula-Selawik Lowlands, Western Brooks Range Mountains, Foothills, and Valleys, Northern Brooks Range Mountains, Arctic Foothills, and Arctic Coastal Plain major land resource areas (USDA, Natural Resources Conservation Service 2006). This area is in the zone of continuous permafrost. Permafrost is shallow or moderately deep, except on steep, coarse-textured soils in the high mountains. Most of the soils in the region are Gelisols, having permafrost within their soil profile. Orthels and Turbels, the dominant suborders, occur on all landforms in the region. Aquorthels and Histoturbels are on the gentler slopes and on poorly drained hillsides. Glacic subgroups occur near the coasts. Mollorthels are on some well-drained, south-facing slopes, and Psammorthels are on dunes. Fibristels formed in thick deposits of organic material in depressions throughout the region. Coarse textured Gelepts and Gelorthents are on some steep hill slopes and ridges. They have a mean annual soil temperature below 32 degrees F (0 degrees C) but do not have permafrost in their soil profile (USDA, Natural Resources Conservation Service 2006).

3.6.3 Climate Change

Some predicted effects of climate change include increased duration and frequency of droughts and an increase in extreme precipitation events. This combination can result in an increase in surface soil erosion and gullying beyond current levels. Continental scale shifts in precipitation may lead to areas where there are increases and decreases in soil moisture. Prolonged drought would also affect soil respiration, resulting in a decreased soil carbon pool (IPCC 2008).

3.7 WATER RESOURCES AND QUALITY

Geothermal resources primarily involve the presence and characteristics of available heat and groundwater. Groundwater is the primary water resource that is potentially affected by geothermal exploration and development. Potential effects to surface water are more limited in area and scope to the immediate vicinity of geothermal exploration and development activities; surface water effects are discussed in detail on a lease-by-lease basis.

Groundwater and surface water rights are not discussed in this section. Water rights are very specific to individual locations, aquifers, landowners, and local jurisdictions. Geothermal developers must obtain the appropriate water rights and state permits, in addition to the Federal lease for the resource.

There are about 26 major aquifer systems in the project area's 11 contiguous western states, excluding Alaska (Figure 3-8). There is little known about aquifers in Alaska except near the towns and cities. Each of these aquifers is unique in that the source, volume, and quality of water flowing through it depends on:

- its hydrogeological conditions (e.g., hydraulic conductivity, effective porosity, and hydraulic gradient);
- external factors (e.g., rates of precipitation, recharge, evaporation, and transpiration);
- the location and hydrologic connection with streams, rivers, springs, reservoirs, and wetlands; and
- overlaying human activities (BLM 2007c).

In general, the aquifers occur in six types of permeable geologic materials: unconsolidated deposits of sand and gravel, semiconsolidated sand, sandstone, carbonate rocks, interbedded sandstone and carbonate rocks, and basalt and other types of volcanic rocks. Rocks and deposits with minimal permeability, which are not considered aquifers, consist of intrusive igneous rocks, metamorphic rocks, shale, siltstone, evaporite deposits, silt, and clay. As such, there is a direct relationship between permeability and type of geologic material. For this reason, the aquifers are categorized according to their general geologic character (USGS 2002b).

In addition, sole-source aquifers are identified in this section. A sole-source aquifer is defined by the US EPA as supplying at least 50 percent of the drinking water consumed in the area overlying the aquifer, where the surrounding area has no alternative drinking water source(s) that could physically, legally, and economically supply all those who depend upon the aquifer for drinking water (US DOE and BLM 2007).

C://EMPSi/GeothermalPEIS/Figures

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SOURCE: BLM 2007c

There are about 26 major aquifer systems in the project area's 11 contiguous western states, excluding Alaska.

Principal Aquifers in the 11 Western States

Figure 3-8

Although the boundaries of groundwater and surface water resources do not always coincide, the discussion below is organized by surface water (hydrologic) regions. As shown on Figure 3-9, nine hydrologic regions have been identified in the project area: Alaska, Arkansas-White-Red, California, Great Basin, Lower Colorado, Missouri, Pacific Northwest, Rio Grande, and Upper Colorado (BLM 2007c). Within the project area hydrologic regions, the areas of greatest interest are public and NFS lands within the planning area. Most public and NFS lands occur in arid to semiarid environments in the Great Basin and Colorado drainage basins (BLM 2007c).

For this PEIS, a hot spring is defined as a spring with water temperatures above 50 °C (122 °F). Warm springs have temperatures between 20 to 50 °C (68 to 122 °F) and are not discussed. Hot and warm springs in the project area are detailed in Appendix F (US Department of Commerce, NOAA 2008).

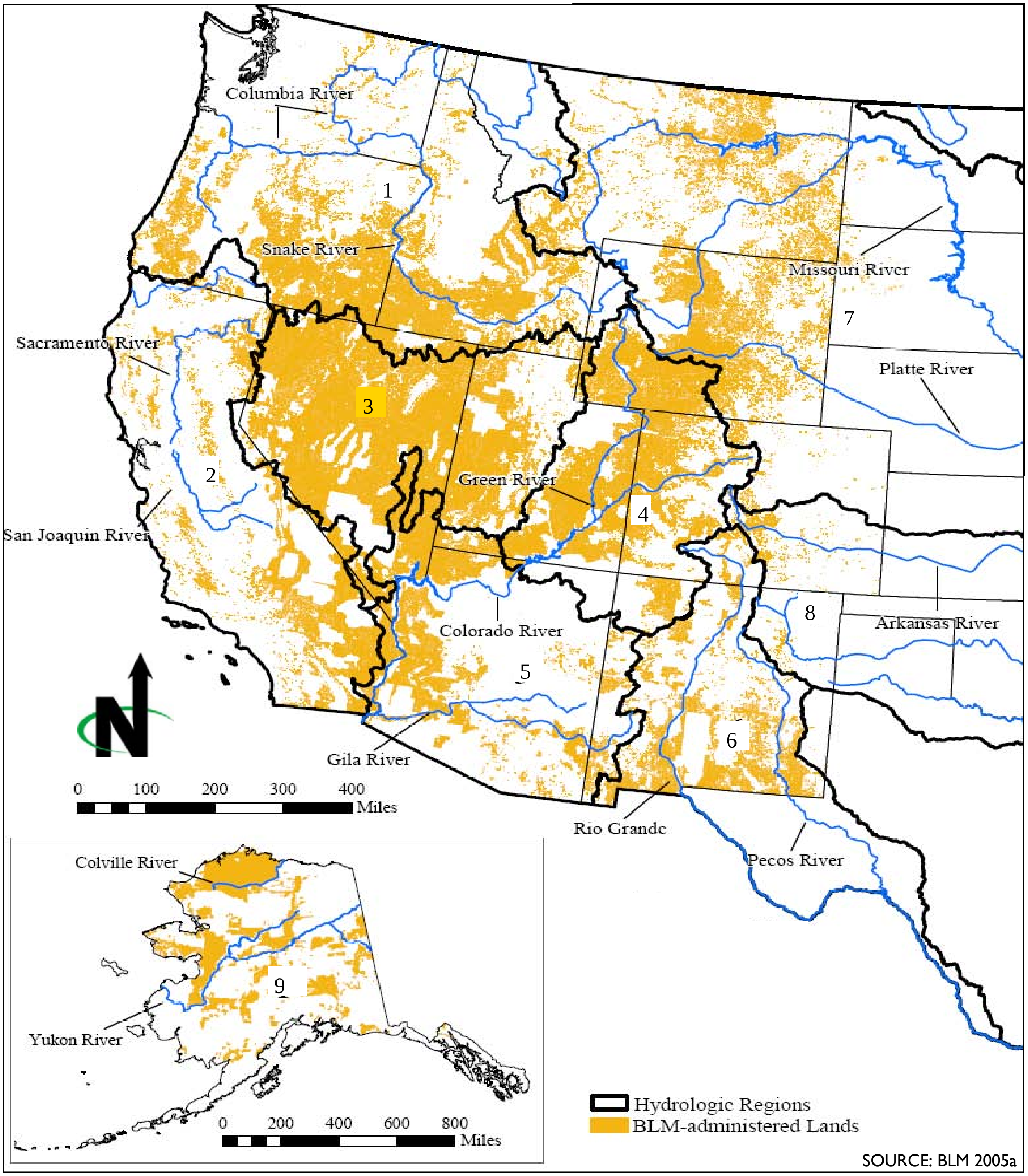
Characteristics by Hydrologic Region

Pacific Northwest Hydrologic Region

The Pacific Northwest Hydrologic Region includes the wet coastal areas of Oregon and Washington, as well as the semiarid Columbia Plateau in eastern Washington, Oregon, and southern Idaho (BLM 2007c). In this region, planning area public and NFS lands are along the Cascade Range, in central Washington, in all of Oregon except the coastal areas, and in all of Idaho except the panhandle. The Pacific Northwest Hydrologic Region encompasses the Puget-Willamette Lowland, Columbia Plateau, Northern Rocky Mountain Intermontane Basins, and the Snake River Plain regional aquifer systems. In addition, there are unconsolidated aquifers, Pliocene and younger basaltic rock aquifers, volcanic and sedimentary rock aquifers, Miocene basaltic rock aquifers, and aquifers in pre-Miocene rocks (USGS 2002b).

The area is geologically and topographically diverse and contains a wealth of ground and surface water resources that generally are suitable for all uses including drinking water (USGS 2002b). The southernmost portion of this hydrologic region extends down to the northern portion of the Great Basin. This area is geologically very new and contains extensive areas of lava and other volcanic rock. The rock substrata are very permeable; therefore, streams tend to lose much of their flow through percolation. (BLM 2007c).

Surface Water. Generally, streams that flow year-round east of the Cascade Range are fed by snowmelt from higher elevations or by groundwater discharge from aquifers recharged during periods of abundant precipitation (BLM 2007c). Tributary streams are short and have steep gradients, creating rapid surface water runoff with relatively short-term water storage, limiting recharge (BLM 2007c). Most of the region is drained by the Columbia River, its tributaries, and other streams that discharge to the Pacific Ocean.



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There are 9 total Hydrologic Regions within the 11 Western States and Alaska.

KEY HYDROLOGIC REGIONS

1. Pacific Northwest
2. California
3. Great Basin
4. Upper Colorado
5. Lower Colorado
6. Rio Grande
7. Missouri
8. Arkansas-White-Red
9. Alaska

Hydrologic Regions in the 11 Western States and Alaska

Figure 3-9

The Columbia River has 10 major tributaries—the Kootenay, Okanagan, Wenatchee, Spokane, Yakima, Snake, Deschutes, Willamette, Cowlitz, and Lewis Rivers (BLM 2007c). The Columbia River Basin extends roughly from the crest of the Coast Ranges of Oregon and Washington, east through Idaho, to the Continental Divide in the Rocky Mountains of Montana and Wyoming; and from the headwaters of the Columbia River in Canada to the high desert of northern Nevada and northwestern Utah. Its main stem, the Columbia River, originates in two lakes that lie between the Continental Divide and the Selkirk Mountain Range in British Columbia. After flowing a circuitous path for approximately 1,200 miles, it joins the Pacific Ocean near Astoria, Oregon (BLM 2007c).

Aridity progressively increases and precipitation decreases east of the Cascade Range because of rain-shadow effects caused by the mountains (BLM 2007c). Only large rivers that lie below the water table contain substantial flows year round. In most years, abundant precipitation along the western side of the Cascade Range produces abundant surface water flow in streams flowing off the Cascade Range to the Pacific Ocean (BLM 2007c). Those streams that do not flow to the Pacific flow to closed basins in southeastern Oregon (USGS 2002b). Many of these systems are rain driven and influenced primarily by winter rain storms (BLM 2007c).

Surface water is abundant in Idaho, Oregon, and Washington, though not always available when and where needed. In some places, surface water provides much of the water used for public-supply, domestic and commercial, agricultural (primarily irrigation and livestock watering), and industrial purposes. In arid parts of the region, however, surface water has long been fully appropriated, chiefly for irrigation. Most irrigation is on lowlands next to streams and on adjacent terraces. Generally, lowlands within a few miles of a main stream are irrigated with surface water diverted by gravity flow from the main stream or a reservoir and distributed through a system of canals and ditches. In some areas, water is pumped to irrigate lands farther from the stream at a higher altitude. (USGS 2002b). Groundwater is used when and where surface water supplies are lacking (USGS 2002b).

Aquifers and streams are in direct hydraulic connection in some places, particularly where the aquifers in the stream valleys consist of unconsolidated deposits. Water can move either from the aquifer to the stream or from the stream to the aquifer, depending on the altitude of the water level in the stream and the aquifer (USGS 2002b).

Groundwater. Groundwater is an important resource in this hydrologic region for domestic consumption and irrigation. It is generally contained in shallow alluvial aquifers along major streams and their valleys (BLM 2007c). Most of the groundwater is produced from aquifers in unconsolidated alluvial sand and gravel deposits that fill large to small basins in the region. These aquifers are virtually independent but share common hydrologic characteristics. These aquifers are important water sources for public-supply, domestic and commercial, agricultural, and industrial needs because of their location in generally flat lowlands where human activities are concentrated. Many large-yield public-supply and irrigation wells and thousands of domestic wells are completed in these types of aquifers, generally in areas of privately owned land (USGS 2002b).

All aquifers in this region were assigned to one of five general types depending on their geologic and hydrologic characteristics: unconsolidated aquifers, Pliocene and younger basaltic rock aquifers, volcanic and sedimentary rock aquifers, Miocene basaltic rock aquifers, and aquifers in pre-Miocene rocks (USGS 2002b).

Unconsolidated-deposit aquifers, which consist primarily of Holocene-, Pleistocene-, Pliocenene-, and Miocene- age sand and gravel, are the most productive and widespread aquifers in the region. These aquifers are prevalent along present and ancestral stream valleys and in lowlands are associated with structural or erosional basins. These unconsolidated-deposit aquifers provide freshwater for most public-supply, domestic, commercial, and industrial purposes. They also are important sources of water for agricultural (primarily irrigation) purposes. The unconsolidated deposits are mostly alluvial deposits, but in places, they consist of eolian, glacial, or volcanic deposits (USGS 2002b).

Pliocene and younger basaltic-rock aquifers consist primarily of thin, basaltic lava flows and beds of basaltic ash, cinders, and sand. The aquifers are most productive in the Snake River Plain of Idaho. These aquifers yield freshwater that is used mostly for agricultural (primarily irrigation) purposes (USGS 2002b).

Volcanic- and sedimentary-rock aquifers consist of a variety of volcanic and sedimentary rocks. These aquifers are not as productive as the aquifers described above. The volcanic rocks that compose the aquifers consist primarily of Pliocene and younger basaltic rocks on the eastern side of the Cascade Range in Oregon and Washington, and silicic volcanic rocks in southern Idaho and southeastern Oregon. Unconsolidated volcanic deposits included in the aquifers are ash and cinders. The sedimentary rocks that compose the aquifers consist primarily of semiconsolidated sand and gravel eroded mostly from volcanic rocks. The aquifers generally yield freshwater but locally yield saltwater. About 30 percent of the fresh groundwater withdrawals are used for public-supply, about 20 percent are used for domestic and commercial, and about 50 percent are used for agricultural (primarily irrigation) purposes (USGS 2002b).

Aquifers in pre-Miocene rocks consist of undifferentiated volcanic rocks, undifferentiated consolidated sedimentary rocks, and undifferentiated igneous and metamorphic rocks that are distributed throughout the region, principally in the mountainous areas. In some places, the thickness of the volcanic rocks might be as much as about 5,000 feet, and that of the consolidated sedimentary rocks might be as much as about 15,000 feet. East of the Cascade Range, the aquifers generally yield freshwater but locally yield saltwater. Within the Cascade Range and west of it, these aquifers commonly yield saltwater. Fresh groundwater withdrawals are used mostly for domestic and commercial purposes (USGS 2002b).

Miocene basaltic-rock aquifers consist primarily of thick basaltic lava flows underlying Pliocene and younger rocks in much of the intervening areas between outcrops. The aquifers are most productive in the Columbia Plateau of northeastern Oregon and southeastern Washington where the aquifers are thickest. The maximum thickness of the aquifers is estimated to be as much as about 15,000 feet in the southern part of the Columbia Plateau. These aquifers generally yield freshwater but locally yield saltwater. Most of the fresh groundwater withdrawals are used for agricultural (primarily irrigation) purposes (USGS 2002b).

The Puget-Willamette Lowland, Columbia Plateau, Northern Rocky Mountain Intermontane Basins, and the Snake River Plain regional aquifer systems are made up of the five types of aquifers discussed above. In southern Oregon and Idaho, these aquifers are part of the extensive basin-fill Basin and Range aquifers. These aquifers are described in more detail as part of the Great Basin Hydrologic Region, described below.

The Snake River Plain, the Columbia Plateau, and the Puget-Willamette Trough aquifer systems consist of extensive sets of aquifers and confining units that might locally be discontinuous but that function hydrologically as a single aquifer system on a regional scale. The major aquifers that compose the Puget-Williamette Trough regional aquifer system are unconsolidated-deposit and Miocene basaltic-rock aquifers in deep basins (USGS 2002b). The Columbia Plateau Regional Aquifer System consists of unconsolidated and Miocene basaltic rock aquifers in northeastern Oregon and southeastern Washington. Permeable zones are at the tops and the bottoms of the basaltic lava flows (USGS 2002b).

In the Snake River Plain of southern Idaho and southeastern Oregon, the aquifers consist of the unconsolidated and the Pliocene and younger basaltic rock aquifers. The layers of lava flows, beds of volcanic ash and tuff, basalt, silicic volcanic rocks, and semiconsolidated to consolidated sedimentary rocks that contain small to large quantities of volcanic material are complexly interbedded, and their permeability is extremely variable. Permeable zones at the tops and the bottoms of these flows yield large volumes of water to irrigation wells. These aquifers also discharge about one million gallons per day to springs in the walls of the Snake River Canyon (USGS 2002b).

The Northern Rocky Mountains Intermontane Basins aquifer systems consists of mainly aquifers in pre-Miocene rocks with some unconsolidated aquifers. They are present mostly in mountainous areas, and water from wells completed in these aquifers is used mostly for domestic and agricultural (livestock watering) supplies (USGS 2002b).

Groundwater Quality. Groundwater in Idaho, Oregon, and Washington generally is fresh (dissolved-solids concentration of 1,000 milligrams per liter or less) and chemically suitable for most uses. Because of sparse settlement in much of the area, little groundwater has been contaminated as the result of human activities, except locally. Measured concentrations of dissolved solids in groundwater exceed 1,000 milligrams per liter only in scattered areas throughout the region (USGS 2002b).

Dissolved-solids concentrations that exceed 500 milligrams per liter are common near coastal areas and in deep aquifers in Idaho, Oregon, and Washington. Most deep aquifers are overlain by shallower aquifers that contain water with smaller dissolved-solids concentrations. However, in some irrigated areas, water in shallow aquifers contains a large dissolved-solids concentration that resulted from percolation of the irrigation water. In central parts of closed basins, evaporation concentrates minerals in shallow groundwater (USGS 2002b).

Areas where dissolved-solids concentrations exceed 500 milligrams per liter reflect: irrigation, chiefly on the Snake River Plain and the Columbia Plateau; saltwater in underlying consolidated marine sedimentary rocks in Oregon and Washington; evaporation in closed basins in south-central Oregon; and geothermal water leaking into the cold freshwater system, chiefly in Idaho and Oregon (USGS 2002b). Table 3-8 identifies the sole-source aquifers in the Pacific Northwest Hydrologic Region as determined by the EPA.

Table 3-8
Pacific Northwest Hydrologic Region Sole-Source Aquifers

Sole-Source Aquifer	Location
Spokane Valley-Rathdrum Prairie Aquifer	WA, ID
Camano Island Aquifer	WA
Whidbey Island Aquifer	WA
Cross Valley Aquifer	WA
Newberg Area Aquifer	WA
Troutdale Aquifer System	WA
North Florence Dunal Aquifer	OR
Cedar Valley Aquifer	WA
Lewiston Basin Aquifer	WA, ID
Eastern Snake River Plain Aquifer	ID, WY
Central Pierce County Aquifer System	WA
Marrowstone Island Aquifer System	WA
Vashon-Maury Island Aquifer System	WA
Guemes Island Aquifer System	WA
Missoula Valley Aquifer	MT

Source: US EPA 2008a

Hot Springs. There are 179 hot springs within the Pacific Northwest Hydrologic Region. Most are in Idaho (3) and Oregon (40), with 14 in Washington, 7 in Montana, 5 in Nevada, and 2 in Wyoming (Appendix F) (US Department of Commerce, NOAA 2008).

California Hydrologic Region

The California Hydrologic Region includes nearly the entire state of California and parts of southern Oregon (BLM 2007c). In this region, the planning area public and NFS lands are in northeastern California and southern Oregon, along the eastern border of California, in scattered areas in southern California, and in a few small areas along the California coast. The California Hydrologic Region encompasses the Basin and Range basin-fill aquifers and carbonate rock aquifers, Central Valley aquifer system, Coastal Basin aquifers, Northern California basin-fill aquifers, and Northern California volcanic rock aquifers, (USGS 2002b). Water needs in California are very large, and the state leads the US in agricultural and municipal water use. The demand for water exceeds the natural water supply in many agricultural and nearly all urban areas. As a result, water is impounded by reservoirs in areas of surplus and transported to areas of scarcity by an extensive network of aqueducts (USGS 2002b).

Surface Water. The California region is drained by rivers such as the Sacramento and San Joaquin. Storms that bring moisture to the region are most frequent in winter. Surface water flow in streams is derived mainly from snowmelt in the mountainous areas during the spring months. Runoff is greater than 40 inches per year in many mountainous areas. During the remainder of the year, many streams have no flow or intermittent flow that follows major storms (BLM 2002).

In southern California, nearly all streams that head in the mountains are ephemeral and lose flow to alluvial aquifers within a short distance of where the streams leave the mountains and emerge onto the valley floors. The basins in the arid parts of southeastern California have virtually zero runoff because most precipitation that falls is evaporated almost immediately. However, high-intensity storms or rapid snowmelt in the mountains that border the basins may cause flash floods that reach the basin floors (USGS 2002b).

Before the inception of agriculture, the largest rivers in California's vast Central Valley overflowed their banks during periods of peak winter flows and formed extensive marshlands. An elaborate flood-control system and the lowering of the water table by withdrawals for irrigation now keep these rivers within their banks (USGS 2002b).

Groundwater. Groundwater in the mountainous areas is relatively deep and is contained in sedimentary units that continue under the intermountain basins and form a deep reservoir that is seldom tapped because of its depth. Shallow groundwater can be found in sands and gravels that fill the basins between the mountain ranges. This groundwater is fed by infiltration of surface water from streams that flow off the mountain ranges. Groundwater in southeastern California is the main source of water for domestic consumption and agricultural irrigation (BLM 2007c).

The Basin and Range aquifers are located in the southern California desert. The water-yielding materials in this area are in valleys and basins, and consist primarily of unconsolidated alluvial-fan deposits. However, locally, floodplain and lacustrine (lake) beach deposits may yield water to wells. Also, the consolidated volcanic and carbonate rocks that underlie the unconsolidated alluvium are a water source if the consolidated rocks are sufficiently fractured or have solution openings. Many of these valleys and basins are internally drained where water from precipitation that falls within the basin recharges the aquifer and ultimately discharges to the land surface and evaporates within the basin. Rarely, basins might be hydraulically connected in the subsurface by fractures or solution openings in the underlying bedrock. Also, several basins or valleys may develop surface-water drainage that hydraulically connects the basins, and groundwater flows between the basins, mostly through the unconsolidated alluvial stream/floodplain sediments (USGS 2002b).

The Central Valley aquifer system occupies most of a large basin in central California between the Sierra Nevada and the Coast Range Mountains. The Central Valley is the single-most important source of agricultural products in the US, and groundwater for irrigation has been essential in the industry's development. The basin contains a single, large, basin-fill aquifer system, the largest such system in the US. Although the valley is filled with tens of thousands of feet of unconsolidated sediments, most of the fresh groundwater is at depths of less than 2,500 feet (USGS 2002b).

The Coastal Basins aquifers occupy a number of basins in coastal areas from northern to southern California. These basins are in structural depressions formed by folding and faulting, filled with marine and alluvial sediments, and drained by streams that contain water at least part of the year. Nearly all the large population centers in California are located in these basins, and the available groundwater is used primarily for municipal supplies. In most of the basins, local groundwater supplies are no longer adequate, and surface water must be transported from distant sources. Seawater intrusion is a common problem in nearly all the Coastal Basins aquifers (USGS 2002b).

The most productive and highly-utilized aquifers in interior northern California are the northern California basin-fill aquifers. These aquifers are in unconsolidated alluvial sediments. However, in some basins, wells drilled into underlying volcanic rocks might produce large quantities of water. Most groundwater demand is for agricultural irrigation (USGS 2002b). The northern California volcanic-rock aquifers consist of volcanic rocks that yield water primarily from fractures and locally from intergranular spaces in porous tuffs.

Water-yielding zones in these rocks are unevenly distributed; however, in some areas, wells completed in the volcanic-rock aquifers yield large volumes of water. The northern California volcanic-rock aquifers are relatively unexplored and undeveloped (USGS 2002b). Table 3-9 identifies the sole source aquifers in the California Hydrologic Region as determined by the EPA.

Table 3-9
California Hydrologic Region Sole-Source Aquifers

Sole-source Aquifer	Location
Fresno County Aquifer	CA
Santa Margarita Aquifer, Scotts Valley	CA
Campo/Cottonwood Creek	CA
Ocotillo-Coyote Wells Aquifer	CA

Source: US EPA 2008b

Hot Springs. There are 75 hot springs within the California Hydrologic Region. Seventy of them are in California, and five are in Oregon (Appendix F) (US Department of Commerce, NOAA 2008).

Great Basin Hydrologic Region

The Great Basin Hydrologic Region includes the Great Basin and encompasses nearly the entire state of Nevada, as well as western Utah (BLM 2007c). In this region, the planning area public and NFS lands include almost the entire region. The Great Basin Hydrologic Region encompasses the Basin and Range basin-fill aquifers and carbonate rock aquifers, the southern Nevada volcanic rock aquifers, and a minor amount of the Colorado Plateau aquifers (USGS 2002b).

Surface Water. The Great Basin Hydrologic Region of Nevada and Utah is an arid region located in the rain-shadow of the Sierra Nevada Mountains. The region is characterized by northerly trending mountain ranges and intermountain valleys with closed drainage. None of the streams that originate within this basin have an outlet to the ocean. The Great Basin's internal drainage results from blockage of water movement by high fault-created mountains and lack of sufficient water flow to merge with larger drainages outside of the Great Basin. This internally drained area occupies approximately 200,000 square miles, including most of Nevada, a large part of Utah, and portions of Idaho, California, and Oregon (USGS 2004f).

This region's surface water sources evaporate or percolate before they can flow to the ocean (USGS 2004f). Precipitation generally falls as rain and mountain snowfall. Streams flowing from the mountains carry water to the basins, which infiltrates into the alluvial sediments and provides the only substantial recharge to basin groundwater. Surface water flow in the basins is derived almost entirely from the mountain streams (BLM 2007c). Any water that falls as rain or snow into this region does not leave (USGS 2004f).

Apart from major rivers (e.g., the Humboldt and Truckee Rivers), surface water flow in the basins of Utah and Nevada is intermittent along the mountain fronts and ephemeral in the basins themselves. Surface water flow in the mountainous areas is limited mainly to late spring snowmelt in the higher areas. Agricultural diversions of major streams exiting the mountains are common, and major rivers are used extensively for irrigation. Surface water flow in northern Nevada has been affected by groundwater pumping from mining areas into the rivers. The Humboldt River, from Battle Mountain to Winnemucca, Nevada, is dominated by mine discharge (BLM 2007c).

Groundwater. The water-yielding materials in the Basin and Range aquifers are in valleys and basins, consisting primarily of unconsolidated alluvial-fan deposits. Local floodplain and lacustrine (lake) beach deposits may also yield water to wells. Also, the consolidated volcanic and carbonate rocks that underlie the unconsolidated alluvium are a water source if the consolidated rocks are sufficiently fractured or have solution openings. Many of these valleys and basins are internally drained where water from precipitation that falls within the basin recharges the aquifer and ultimately evaporates within the basin. Rarely, basins might be hydraulically connected in the subsurface by fractures or solution openings in the underlying bedrock. Also, several basins or valleys may develop surface water drainage that hydraulically connects the basins, and groundwater flows between the basins, mostly through the unconsolidated alluvial stream/floodplain sediments (USGS 2002b).

Within the Basin and Range Province, aquifers are not continuous, or regional, because of the complex faulting in the region. Three principal aquifer types are collectively called the Basin and Range aquifers: volcanic-rock aquifers, carbonate-rock aquifers, and basin-fill aquifers. The volcanic-rock aquifers, located in south-central Nevada, are primarily tuff, rhyolite, or basalt of Tertiary age. The carbonate-rock aquifers, which are primarily limestones and dolomites of Mesozoic and Paleozoic age, underlie many of the alluvial basins in eastern Nevada, western Utah, and southeastern Idaho. Conditions indicate that the carbonate rock is cavernous. The basin-fill aquifers are primarily unconsolidated sand and gravel of Quaternary and Tertiary age. The most permeable basin-fill deposits are present in the depressions created by late Tertiary to Quaternary block faulting and can be classified by origin as alluvial-fan, lake-bed, or fluvial deposits. Any or all three aquifer types may be in, or underlie, a particular basin and constitute three separate sources of water; however, the aquifers may be hydraulically connected to form a single source. Other rock types within the region have low permeability and act as boundaries to the flow of fresh groundwater (USGS 2002b).

In the extreme eastern part of the region, in central Utah, the region encompasses a small part of the Colorado Plateau aquifers. These aquifers are described in the Upper Colorado Hydrologic Region section, below.

Shallow groundwater in the alluvium of the basins is the main source of water for domestic consumption, irrigation, and power plant cooling. Some areas of the Great Basin, particularly in northern Nevada, have geothermal reservoirs that underlie the shallow groundwater reservoirs. These geothermal waters have been tapped, often inadvertently, by open pit mining and dewatering of areas used for gold mining. The Great Basin contains many of the largest groundwater reservoirs in the US. These reservoirs are largely untapped at present, but major urban areas like Las Vegas, Nevada, are actively pursuing their development (BLM 2007c).

Groundwater Quality. The dissolved solids concentrations in the water in the basin-fill aquifers are generally less than 1,000 milligrams per liter but exceed 10,000 milligrams per liter in the Great Salt Lake Desert and near the Great Salt Lake. The Western Uinta Arch Paleozoic Aquifer System is the only sole-source aquifer identified by the EPA in the Great Basin Hydrologic Region (US EPA 2008b).

Hot Springs. There are 139 hot springs within the Great Basin Hydrologic Region. Most are in Nevada (115), with 12 in Utah, 8 in California, and 4 in Idaho (Appendix F) (US Department of Commerce, NOAA 2008).

Upper Colorado Hydrologic Region

The Upper Colorado Hydrologic Region includes southwestern Wyoming, eastern Utah, western Colorado, northeastern Arizona, and northwestern New Mexico (BLM 2007c). In this region, the planning area public and NFS lands include southwestern Wyoming, eastern Colorado, and northwestern New Mexico. The Upper Colorado Hydrologic Region encompasses the Colorado Plateau aquifer (USGS 2002b).

Surface Water. Perennial surface water flow occurs in major rivers (e.g., Green and Colorado Rivers). The upper reaches of the Colorado River and its tributaries drain this region. Precipitation varies greatly with elevation and occurs as winter snows and heavy autumn rainstorms. In southwestern Colorado, summer monsoonal flow produces ample rain. Major streams are fed by snowmelt in mountainous areas. The larger rivers in Colorado are perennial, but the smaller rivers and streams are either intermittent or ephemeral. Dams serve as flood control, domestic supply, and power generation for the major urban centers, as well as providing surface water for irrigation. Farming and ranching are usually limited to stream valleys, where irrigation water comes mostly from surface water (BLM 2007c).

Groundwater. Groundwater is found in most of the sedimentary rocks of the Colorado Plateau and is the major source of water for domestic and municipal use. Seeps and springs are an historic source of water for Native American tribes and a current source of water for smaller ranches (BLM 2007c). The distribution of aquifers in the Colorado Plateau is controlled in part by the structural deformation and erosion that has occurred since deposition of the sediments that compose the aquifers. The principal aquifers in younger rocks are present only in basins such as the Uinta, Piceance, and San Juan. In uplifted areas, younger rocks have been eroded away, and aquifers are present in older rocks that underlie more extensive parts of the Colorado Plateau area (USGS 2002b). Major aquifer systems are not present.

In general, the aquifers in the Colorado Plateau area are composed of permeable, moderately to well-consolidated sedimentary rocks. These rocks range in age from Permian to Tertiary and vary greatly in thickness, lithology, and hydraulic characteristics. Many water-yielding units in the area have been grouped into four principal aquifers for purposes of discussion. These include the Uinta-Animas aquifer, the Mesaverde aquifer, the Dakota-Glen Canyon aquifer system, and the Coconino-De Chelly aquifer. Most widespread and productive water-yielding units are included in these aquifers; however, there are some locally productive water-yielding units (USGS 2002b).

The Uinta-Animas aquifer primarily is composed of Lower Tertiary rocks in the Uinta Basin of northeastern Utah, the Piceance Basin of northwestern Colorado, and the San Juan Basin of northwestern New Mexico. Aquifers in each basin are present in different parts of the stratigraphic section. Some formations are considered to be an aquifer in more than one basin; however, some formations vary so much in their hydraulic characteristics that they are considered to be an aquifer in one basin and a confining unit in another (USGS 2002b).

The Mesaverde aquifer comprises water-yielding units in the Upper Cretaceous Mesaverde Group, its equivalents, and some adjacent Tertiary and Upper Cretaceous formations. The Mesaverde aquifer is at or near land surface in extensive areas of the Colorado Plateaus and underlies the Uinta-Animas aquifer. The aquifer is of regional importance in the Piceance, Uinta, Kaiparowits, Black Mesa, and San Juan Basins and is of lesser importance in the Wasatch Plateau and High Plateaus areas. Some of the rocks that form the Mesaverde aquifer contain coal beds, some of which have been mined for at least a century. The hydrologic effects of mining have been of increasing concern in the areas underlain by the aquifer. The quality of the water in the Mesaverde aquifer is extremely variable (USGS 2002b).

The Dakota-Glen Canyon aquifer system is defined here as those water-yielding rocks ranging in age from late Cretaceous to Triassic underlying most of the Colorado Plateau area. These rocks contain a series of aquifers and confining units. These aquifers are grouped together as an aquifer system because they are separated everywhere from overlying and underlying aquifers by thick confining units, and because some hydraulic connection exists between each of the aquifers in the system at some point in the Colorado Plateau area. In much of the area underlain by the aquifer system, the great depth to the aquifers or poor water quality makes the aquifers unsuitable for development. However, in areas where an aquifer is near land surface, the aquifer may be an important water source (USGS 2002b).

The rocks referred to as the Coconino-De Chelly aquifer are water-yielding rocks of Early Permian age underlying the southern part of the Colorado Plateau. The formations that comprise the Coconino-De Chelly aquifer are the Coconino, De Chelly, and Glorieta Sandstones; the San Andres Limestone; and the Yeso and Cutler Formations (USGS 2002b).

Relatively impermeable confining units separate each of the four principal aquifers in the Colorado Plateau. Thinner and less-extensive confining units separate some water-yielding zones within the principal aquifers; however, these units generally form less-effective barriers to groundwater movement. Where the intra-aquifer confining units are thin or absent, water can move between adjacent water-yielding zones within an aquifer (USGS 2002b).

Groundwater Quality. Although the quantity and chemical quality of water in the Colorado Plateau aquifers are extremely variable, much of the land in this sparsely populated region is underlain by rocks that contain aquifers capable of yielding usable quantities of water of a quality suitable for most agricultural or domestic use (USGS 2002b). Table 3-10 identifies the sole-source aquifers in the Upper Colorado Basin Hydrologic Region as determined by the EPA.

Table 3-10
Upper Colorado Hydrologic Region Sole-Source Aquifers

Sole-source Aquifer	Location
Glen Canyon Aquifer	UT
Castle Valley Aquifer	UT

Source: US EPA 2008c

Hot Springs. There are 14 hot springs within the Upper Colorado Hydrologic Region, 11 of which are in Colorado and 3 of which are in Utah (Appendix F) (US Department of Commerce, NOAA 2008).

Lower Colorado Hydrologic Region

The Lower Colorado Hydrologic Region includes almost all of Arizona, western New Mexico, and parts of southeastern Nevada, southeastern California, and southwestern Utah (BLM 2007c). In this region, planning area public and NFS lands are in southwestern Arizona, western New Mexico, and parts of southeastern Nevada, Southeastern California, and Southwestern Utah. The

Upper Colorado Hydrologic Region encompasses the Basin and Range basin-fill aquifers and carbonate rock aquifers, Colorado Plateau aquifers, and a minor portion of the Rio Grande Aquifer system (USGS 2002b).

Surface Water. This hydrologic region is comprised of the lower reaches of the Colorado River in the desert southwest of Arizona, New Mexico, and southern Nevada. In this region, public lands are mainly restricted to the arid valleys, while many of the upland areas are administered by the FS. The climate is arid, and precipitation is limited to the winter months and periods of heavy storms. Most precipitation during summer evaporates before it can infiltrate into the desert sands (BLM 2007c).

Surface water flow in the arid basins of the southwest is ephemeral to nonexistent most of the year. Spring snowmelt and periods of heavy winter rain result in surface water flow in the mountainous areas and along the intervening basins' mountain fronts. During the rest of the year, surface water flow is absent except after major storms, where flash floods are common along mountain fronts. Only major rivers draining the Colorado Plateau or the Mogollon Rim, such as the Gila and Bill Williams Rivers, have perennial flow. (BLM 2007c)

Groundwater. The Basin and Range basin-fill aquifers, Basin and Range carbonate rock aquifers, and the Colorado Plateau aquifers are described previously. The Rio Grande Aquifer is described as part of the Rio Grande Hydrologic Region section, described below.

Groundwater is found in the alluvium of basins and in the bedrock of mountainous areas (i.e., reservoirs to many thousands feet deep). Groundwater is recharged by precipitation in the mountains and infiltration of stream flow along the base of the mountains. The shallow groundwater reservoirs are used extensively for irrigation and domestic consumption. Irrigation demand and mine dewatering have substantially lowered the water levels in the shallow groundwater reservoirs of the Arizona basins. However, groundwater levels in the basins of southern New Mexico have not been substantially affected by irrigation. Many of the basins have shallow groundwater surfacing in playa lakes (BLM 2007c).

Groundwater Quality. The concentration of dissolved fluoride in groundwater in southern Arizona is close to or exceeds the US EPA Drinking Water Regulations Maximum Contaminant Level for dissolved fluoride (4 milligrams per liter) for drinking-water supplies in parts of some basins in Arizona. (USGS 2002b). Table 3-11 identifies the sole-source aquifers in the Lower Colorado Basin Hydrologic Region as determined by the EPA.

Table 3-11
Lower Colorado Hydrologic Region Sole-Source Aquifers

Sole-source Aquifer	Location
Upper Santa Cruz and Avra Basin Aquifer	AZ
Bisbee-Naco Aquifer	AZ

Source: US EPA 2008b

Hot Springs. There are 13 hot springs within the Lower Colorado Hydrologic Region, including 6 in New Mexico, 6 in Arizona, and 1 in Nevada (Appendix F) (US Department of Commerce, NOAA 2008).

Rio Grande Hydrologic Region

The Rio Grande Hydrologic Region includes almost all of New Mexico, as well as south-central Colorado (BLM 2007c). In this region, planning area public and NFS lands are in parts of south-central Colorado, north central New Mexico, and southern New Mexico. The Rio Grande Hydrologic Region encompasses the Rio Grande Aquifer system, the Pecos River Basin alluvial aquifer, the Roswell Basin Aquifer, the southeastern portion of the Colorado Plateau aquifers, and the northern extremes of the Pecos River Basin alluvial aquifer (USGS 2002b).

Surface Water. The Rio Grande and Pecos River are major surface water resources that derive their water from the mountainous regions of southern Colorado and flow through New Mexico and Texas to the Gulf of Mexico. The Rio Grande is the largest river in the area and has perennial flow through most of its length in Colorado and New Mexico. The river flows across the broad basin-fill deposits in Colorado, through deep canyon and small intermountain basins in northern New Mexico, and through a series of broad basins and narrow valleys to the state line in southern New Mexico (USGS 2002b). Most basins along the Rio Grande have surface drainage to the river and are topographically open basins. The northern end of the San Luis Valley and most other basins distant from the river have internal surface-water drainage and generally do not contribute stream flow to the Rio Grande (USGS 2002b).

Surface water flow is present year round in the Rio Grande. Much of the stream flow in the more-mountainous northern part of the Rio Grande is derived from mountain snowmelt runoff. Stream flow in the southern part of the river system is derived from upstream flow, groundwater discharge, and summer thunderstorm runoff (USGS 2002b). Agricultural diversions account for approximately 90 percent of surface water use and may result in practically no flow during the summer months (BLM 2007c).

Groundwater. The Rio Grande aquifer system is the principal aquifer in a 70,000-square-mile area of southern Colorado and central New Mexico. The aquifer system consists of a network of hydraulically interconnected aquifers in basin-fill deposits located along the Rio Grande Valley and nearby valleys (USGS 2002b). These aquifers are generally composed of unconsolidated sediment deposits present in intermountain basins between discontinuous mountain ranges in southern New Mexico and between mountains and tablelands in northern New Mexico. High mountains border the aquifers in southern Colorado (USGS 2002b). Groundwater recharge primarily originates as precipitation in the mountainous areas surrounding the basins, while most of the precipitation that falls in the valleys is lost to evaporation and transpiration (BLM 2007c).

Most groundwater withdrawal occurs as discharge from pumping wells, of which about 90 percent is used for irrigation of commercial crops. Most cities and communities in the area, such as Albuquerque, Las Cruces, and Santa Fe, New Mexico, rely on groundwater for municipal use. Groundwater withdrawals in closed basins have caused long-term water level declines, while withdrawals from wells located near the Rio Grande or its perennial tributaries generally do not cause long-term water level declines in the aquifer (BLM 2007c).

The Roswell Basin aquifer system consists of an underlying carbonate-rock aquifer and a hydraulically connected, overlying alluvial aquifer. The carbonate-rock aquifer primarily has been formed by solution openings in extensive limestone and dolomite formations of Permian age. The alluvial aquifer is in unconsolidated gravel, sand, silt, and clay that overlies the eastern part of the carbonate-rock aquifer. The alluvial aquifer hydraulically connects the carbonate-rock aquifer with surface flow in the Pecos River, which flows through the Roswell Basin (USGS 2002b).

Thick and extensive alluvial deposits of Cenozoic age compose the Pecos River Basin alluvial aquifer in extreme southeastern New Mexico and western Texas. The topography in the area consists mostly of flat to rolling plains that slope gently toward the Pecos River. Groundwater in the Cenozoic alluvium is of major importance in this area where average annual rainfall is less than 12 inches (USGS 2002b). The Espanola Basin Aquifer System is the only sole-source aquifer identified by the EPA in the Rio Grande Hydrologic Region (US EPA 2008d).

Hot Springs. There are 11 hot springs within the Rio Grande Hydrologic Region, of which 8 are in New Mexico and 3 are in Colorado (Appendix F) (US Department of Commerce, NOAA 2008).

Missouri Hydrologic Region

The Missouri Hydrologic Region includes most of Montana and Wyoming, as well as northwestern Colorado. In this region, planning area public and NFS lands are in parts of southwestern Montana, the basins of central Wyoming, and small parts of central Colorado. The Missouri Hydrologic Region encompasses the Northern Great Plains aquifer, the Central Midwest (Great Plains) aquifer system, the High Plains aquifer, and the Denver Basin aquifer. A small part of the western edge of the region (bordering Idaho) includes the Northern Rocky Mountains Intermontane Basin aquifer system. This aquifer system is described under the Pacific Northwest Hydrologic Region, as described previously (USGS 2002b).

Surface Water. This hydrologic region encompasses the eastern front of the Rocky Mountains stretching to the Great Plains, most of which is drained by the Missouri and Platte Rivers and their tributaries (BLM 2007c). The Missouri River system and the North Platte River drain eastward and southeastward to the Mississippi River, which discharges to the Gulf of Mexico (USGS 2002b). These rivers and their tributaries are an important source of water for public-supply, domestic and commercial, agricultural, and industrial uses. Much of the surface water has long been appropriated for agricultural use, primarily irrigation, and for compliance with downstream water pacts. Reservoirs store some of the surface water for flood control, irrigation, power generation, and recreational purposes (USGS 2002b). The demand for water is directly related to the distribution of people. The more densely populated areas are on lowlands near major streams. Many of the mountain, desert, and upland areas lack major population centers, particularly in Montana and Wyoming, where use of much of the land is controlled by the federal and withdrawal of groundwater is restricted (USGS 2002b).

Surface water resources are dominated by the major rivers and their tributaries. Average annual runoff in the region varies greatly (USGS 2002b). Precipitation is generally sparse in the summer and fall months, and surface water flow is generally dependent on snowmelt in the mountainous areas. Rivers flow mainly from late spring to early fall and can be dry in some parts of the region during the winter months (BLM 2007c). In arid and semiarid areas of the region, most precipitation replenishes soil moisture, evaporates, or is transpired by vegetation, and only a small part of the precipitation is left to maintain stream flow or recharge aquifers (USGS 2002b). Surface water is directly connected to groundwater through shallow alluvial aquifers that are found along all the major rivers and their tributaries (BLM 2007c). Runoff is affected in some areas by reservoirs that have been constructed on major streams to mitigate flooding and to store water for irrigation, electrical power generation, and recreation. Water stored in reservoirs during times when runoff is great is subsequently released during drier periods to maintain downstream flow (USGS 2002b).

Groundwater base flow supplies stream and river flow in the late summer and fall. Surface water is the main source of municipal and irrigation water in the Rocky Mountain region, and irrigation return flow is a major component of surface water flow (BLM 2007c).

Groundwater. Groundwater in Wyoming and western Montana is found both in the igneous rocks of the uplifts and the thick sedimentary fill in the basins, although groundwater in the uplifts is generally not used. Groundwater is used extensively for irrigation, much of it becoming irrigation return water that flows into major streams and their tributaries. In addition to irrigation, groundwater is also used for municipal and domestic water supplies. Recharge comes only from stream infiltration and spring snowmelt (BLM 2007c). The High Plains, Northern Great Plains, and Central Midwest aquifer systems in the region are extensive sequences of aquifers and confining units, which are usually, but not always, arranged as stacks of layers, that might be discontinuous locally but function regionally as a single aquifer systems (USGS 2002b).

High Plains. The High Plains aquifer underlies parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming. The aquifer is the principal source of water in one of the major agricultural areas of the US. Most wells completed in the High Plains aquifer system obtain water from upper Tertiary aquifers that consist of the Ogallala Formation of Miocene age and the Arikaree Formation of Miocene and Oligocene age. The unconsolidated sand and gravel beds of the Ogallala Formation yield water much more readily than the sandstone beds of the Arikaree Formation. The consolidated siltstone and sandstone of the Brule Formation of Oligocene age yield highly variable volumes of water; yields are greatest where the beds have been fractured. Valley-fill and dune deposits of Quaternary age are hydraulically connected to the aquifers in Tertiary rocks and are included in the High Plains aquifer system. These permeable deposits are important recharge areas because they readily absorb and temporarily store precipitation before it percolates downward to recharge underlying permeable beds. Except for dune sands, which were deposited by wind, all the rocks and deposits that compose the High Plains aquifer system were deposited by streams. The streams probably were braided streams that flowed eastward from the Rocky Mountains and constantly shifted their channels across a broad plain that sloped gently to the east. Depth to water in the High Plains aquifer system ranges from less than 50 to almost 300 feet (USGS 2002b).

Water quality in the High Plains aquifer system in South Dakota and Wyoming is suitable for most uses practically everywhere. Locally, dissolved-solids concentrations in the water exceed the 500-milligram-per-liter secondary maximum contaminant level recommended for drinking water by the US EPA (USGS 2002b).

Northern Great Plains. The Northern Great Plains aquifer system underlies most of North Dakota and South Dakota, about one-half of Montana, and about one-third of Wyoming. The permeable rocks of the Northern Great Plains aquifer system have been grouped into five major aquifers. From shallowest to deepest, these are lower Tertiary, upper Cretaceous, lower Cretaceous, upper Paleozoic, and lower Paleozoic aquifers. All or parts of several geologic formations are included in each of the five major aquifers (USGS 2002b).

The aquifer system is mostly within the Williston Basin in eastern Montana and the western Dakotas, the Powder River Basin in northeastern Wyoming, and areas of structural uplifts that flank these basins. The major aquifers of the Northern Great Plains aquifer system are sandstones of Tertiary and Cretaceous age and carbonate rocks of Paleozoic age. These aquifers, along with regional confining units that separate some of them, form one of the largest confined aquifer systems in the US. In some places, local confining units separate the major aquifers into smaller, individual aquifers, but each major aquifer can be treated regionally as a single, large aquifer (USGS 2002b).

Regional movement of water in the Northern Great Plains aquifer system is from recharge areas at high altitudes, down the dip of the aquifers, and then upward to discharge into shallower aquifers or to the land surface. Much of the water moves into and through the Powder River and the Williston Basins. Much of the discharge from the aquifer system is by upward leakage of water into shallower aquifers where the hydraulic head in the shallower aquifer is less than that of a deeper aquifer. Some discharge from the Northern Great Plains aquifer system also is by withdrawals from wells or from flowing wells in places where artesian pressure is sufficient to allow water in confined aquifers to rise above the land surface (USGS 2002b).

Central Midwest. The Central Midwest aquifer system encompasses the eastern half of Colorado and small parts of northeastern New Mexico and southeastern Wyoming. The Central Midwest regional aquifer system includes the Great Plains aquifer subsystem. The Great Plains aquifer subsystem consists of two sandstone aquifers separated by a shale-confining unit, all of which are in Lower Cretaceous rocks. The aquifer system is overlain by a thick sequence of Upper Cretaceous shale beds that are part of several geologic formations but which function together as a single confining unit, the Great Plains confining system (USGS 2002b).

The upper aquifer, the Maha aquifer, consists chiefly of Dakota, Newcastle, or Muddy Sandstones or equivalent rocks. The lower aquifer, the Apishapa aquifer, consists mostly of the Cheyenne Sandstone or its equivalent, the Inyan Kara Group. The confining unit that separates the two aquifers is mostly the Skull Creek or the Thermopolis Shales or equivalent shale beds (USGS 2002b).

The Denver Basin aquifer system consists of a layered sequence of four aquifers in beds of permeable conglomerate, sandstone, and siltstone. Layers of relatively impermeable shale separate the aquifers and impede the vertical movement of groundwater between the aquifers. The northern part of this aquifer system underlies the surficial aquifer of the South Platte River. Although the Denver Basin aquifer system and the surficial aquifer are hydraulically connected in part of this area, they primarily function as separate aquifer systems (USGS 2002b). The Elk Mountain Aquifer in Wyoming is the only sole-source aquifer identified by the EPA in the Missouri Hydrologic Region (US EPA 2008c).

Hot Springs. There are over 100 hot springs within the Missouri Hydrologic Region. Most are in the Yellowstone National Park area, which has over 90 known hot springs. Three other hot springs are in Wyoming outside of Yellowstone National Park, and 13 others are in Montana (Appendix F) (US Department of Commerce, NOAA 2008).

Arkansas-White-Red Hydrologic Region

In the western US, the Arkansas-White-Red Hydrologic Region includes southeastern Colorado and northeastern New Mexico. In this region, there are only sporadic small parcels of planning area public and NFS lands. The region encompasses the High Plains aquifer system.

Surface Water. This hydrologic region occupies the drainage of the Arkansas, Canadian, and Red River basins above the points of the highest backwater effect of the Mississippi River. It includes all of Oklahoma and parts of Colorado, New Mexico, Texas, Kansas, Missouri, and Louisiana. Only a relatively small proportion of public and NFS lands are found in this region, primarily concentrated near the headwaters of the Arkansas River in central Colorado and near the headwaters of the Canadian River in northeastern New Mexico (BLM 2007c). Surface waters generally originate from precipitation falling in the eastern Rocky Mountains. Precipitation is relatively sparse in the summer and fall months, and surface water flow is typically dependent on snowmelt in the mountainous areas. Surface water resources are used extensively for agricultural irrigation (BLM 2007c).

Groundwater. The High Plains aquifer underlies the western edges of Colorado and New Mexico. The High Plains aquifer is described previously for the Missouri Hydrologic Region.

Surficial aquifers present in many parts of the region generally contain the shallowest groundwater in the area. These aquifers consist of Quaternary deposits of alluvial gravel, sand, silt, and clay or Quaternary deposits of eolian sand and silt. The alluvial and eolian deposits of the Arkansas River Valley are moderately thick and extensive and contain a major surficial aquifer (USGS 2002b). There are no sole-source aquifers identified by the EPA in the Arkansas-White-Red Hydrologic Region (US EPA 2008c, US EPA 2008d)

Hot Springs. There are two hot springs within this region, one in New Mexico and one in Colorado (Appendix F) (US Department of Commerce, NOAA 2008).

Alaska Hydrologic Region

The Alaska Hydrologic Region occupies the entire state of Alaska. In this region, planning area public and NFS lands are in an east-west band across the middle of the state, along the Aluetian Island mountain chain in the south, and on the southeastern coast.

Surface Water. This hydrologic region occupies all of Alaska and is characterized by abundant water resources. Major river systems, such as the Yukon, drain the mountain ranges, and extensive wetlands dot the low-lying plains and coastal regions (BLM 2007c). Alaska is geologically and topographically diverse and contains abundant natural resources, including groundwater and surface water of chemical quality that is generally suitable for most uses (USGS 2002b).

The Yukon and Kuskokwim River drainages are two of the dominant drainages in Alaska. Central Alaska is drained by the Yukon River, which drains an area of more than 330,000 square miles, making it the fourth-largest drainage basin in North America. Its main stem, the Yukon River, originates in northwestern Canada and extends through central Alaska, discharging into the Bering Sea. Major tributaries of the Yukon River include the Tanana, Nenana, Koyukuk, Tanana, and Chena Rivers (BLM 2007c).

The Kuskokwim River drains a large part of southwestern Alaska is the state's second-largest drainage. The glacially turbid main stem is approximately 900 miles long, originating from the interior headwaters of the Kuskokwim Mountains and the shadows of the Alaska Range. The Kuskokwim River flows in a southwest direction to the Bering Sea (BLM 2007c).

The Noatak River in northwestern Alaska discharges into the Chukchi Sea. Major rivers in southern Alaska include the Susitna and the Matanuska Rivers, which discharge into Cook Inlet, and the Copper River, which discharges into the Gulf of Alaska. North of the Brooks Range, the Colville and the Sagavanirktok Rivers and numerous smaller streams discharge into the Arctic Ocean (USGS 2002b).

Low mountains, plateaus, and highlands bound the high mountains and are, in turn, bounded by lowland areas. The lowlands are primarily along the courses of major streams and in coastal areas. Most of the population is concentrated in the cities of Anchorage, Fairbanks, and Juneau, all of which are located in lowland areas. The mountains, the frozen Arctic desert, the interior plateaus, and the areas covered with glaciers lack major population centers. Large parts of Alaska are uninhabited, and much of the state is federal land (BLM, National Park Service, and USFWS). Groundwater development has not occurred over most of these remote areas (USGS 2002b).

Groundwater. Information on subsurface geology, groundwater, and permafrost is sparse in Alaska. In large parts of the state, the surface geology is not well known. Local variations in geologic and permafrost conditions significantly affect the occurrence and movement of groundwater (USGS 2002b).

Hydrologic processes are strongly affected by the presence of permafrost, which may thaw seasonally or be continuous throughout the year, particularly on the

North Slope. In central Alaska, permafrost is discontinuous, and an active layer at the surface that thaws during the summer months can supply groundwater for domestic use. The major river valleys have alluvial aquifers with an active layer in the summer months that also supplies good-quality groundwater. During the winter, permafrost generally extends to the surface, impeding water infiltration and groundwater recharge (BLM 2007c).

The aquifers of Alaska have never been mapped, except in the immediate vicinity of some of the towns and cities such as Kenai, Anchorage, Juneau, and Fairbanks. In other places, data from widely scattered drill holes, combined with maps of the surficial geology, allow some inference about the availability of groundwater. In many areas, deposits of coarse-grained, unconsolidated alluvial and glacial-outwash deposits of Quaternary age, such as the Tanana River basin, comprise thick aquifers that yield large quantities of water to wells. In other areas, such as the Copper River basin, widespread Quaternary deposits consist mostly of lacustrine (lake) silt and clay that are underlain by saline water and do not comprise aquifers. In the coastal area between Norton Sound and Bristol Bay, Quaternary deposits extend over large areas but are generally too fine grained to yield significant amounts of water. However, sand and gravel deposits, such as those that provide the water supply for Bethel, locally form productive aquifers. From the Brooks Range northward to the Arctic Ocean, Quaternary deposits contain continuous permafrost and, therefore, are not aquifers. In the northern part of the discontinuous permafrost zone, the alluvial and outwash deposits are frozen during much of the year, and exploration for local sources of groundwater has generally not been conducted. In this region, however, scattered occurrences of large surface accumulations of ice during the winter indicate the presence of local aquifers (USGS 2002b).

Unconsolidated Quaternary deposits may locally be as thick as 1,000 feet in large basins such as the Yukon, Kuskokwim, Tanana, and Copper Rivers. The entire thickness, however, does not yield water. Igneous, metamorphic, and sedimentary rocks underlie about 70 percent of Alaska. Although these rocks generally yield smaller water amounts to wells than coarse-grained alluvial and outwash deposits, they are important aquifers in some parts of the state. In the Fairbanks area, approximately half the residents obtain water from wells completed in bedrock. Large springs issue from carbonate rocks in the eastern part of the Brooks Range. Carbonate bedrock on Admiralty Island in southeastern Alaska also yields large quantities of water from well-developed cave systems (USGS 2002b). There are no identified sole-source aquifers identified by the EPA in the Alaska Hydrologic Region (US EPA 2008a).

Hot Springs. There are 78 hot springs within the Alaska Hydrologic Region, approximately a third of which are located in the Aleutian Island mountain chain (Appendix F) (US Department of Commerce, NOAA 2008).

3.7.1 Climate Change

Some effects on water resources resulting from climate change include changes in stream systems, such as flow, temperature, and turbidity, as well as effects on glacial systems, which are advancing or receding, depending on local conditions (IPCC 2007).

3.8 AIR QUALITY AND ATMOSPHERIC VALUES

3.8.1 Applicable Plans, Policies and Regulations

The Clean Air Act was passed in 1970 (and amended in 1990) to reduce air pollution across the US. Specific air pollutants associated with harming human health were identified as criteria pollutants. The criteria pollutants were assigned acceptable airborne concentration levels, and collectively the list was named the National Ambient Air Quality Standards. Under the Clean Air Act, the US EPA is responsible for revising these standards when necessary as new air quality data and related impacts on the human environment become available. The Act also mandates the US EPA approve state implementation plans to ensure that local agencies comply with the Act.

More recently, the US EPA issued two new air quality regulations to control air pollution in the US. On March 15, 2006, they issued the Clean Air Mercury Rule to permanently cap and reduce mercury emissions from coal-fired power plants for the first time.

3.8.2 Criteria Pollutants

The US EPA established National Ambient Air Quality Standards for the following six criteria pollutants to protect public health and welfare: sulfur dioxide (SO2), nitrogen dioxide (NO2), carbon monoxide (CO), ozone (O3), lead (Pb), and particulate matter (PM).

Particulate matter, or particulate pollution, is a complex mixture of extremely small particles and liquid droplets. Particle pollution is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles. The size of particles is directly linked to their potential for causing health problems. The US EPA regulates particles that are 10 micrometers in diameter or smaller because those are the particles that generally pass through the throat and nose and enter the lungs. Once inhaled, these particles can affect the heart and lungs and cause serious health effects. The US EPA groups particulate pollution into two categories:

- Inhalable coarse particles, such as those found near roadways and dusty industries, are larger than 2.5 micrometers and smaller than 10 micrometers in diameter (PM10).
- Fine particles, such as those found in smoke and haze, are 2.5 micrometers in diameter and smaller (PM2.5). These particles can be directly emitted from sources such as forest fires, or they can form when gases emitted from power plants, industries and automobiles react in the air.

The National Ambient Air Quality Standards (Table 3-12) and are divided into primary and secondary categories. Primary standards set limits to protect public health, including the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. Averaging periods vary by criteria pollutants based on potential health and welfare effects of each pollutant. The National Ambient Air Quality Standards are enforced by the states via local air pollution agencies. Some states have adopted their own air quality standards that are either as stringent as, or more stringent than, the National Ambient Air Quality Standards.

Table 3-12
National Ambient Air Quality Standards

Pollutant	Averaging Times	Ambient concentration standard[1]	Primary (P) or Secondary (S) standard[2]
Carbon monoxide	1 hour	35 ppm (40 mg/m^3)	P
	8 hours	9 ppm (10 mg/m^3)	P
Lead	Quarterly Average	1.5 µg/m^3	P,S
Nitrogen dioxide	Annual	0.053 ppm (100 µg/m^3)	P,S
PM_{10}	24 hours	150 µg/m^3	P
	Annual	Revoked	P
$PM_{2.5}$	24 hours	35 µg/m^3	P
	Annual	15 µg/m^3	P,S
Ozone	1 hour	0.12 ppm	P,S
	8 hours	0.08 ppm	P,S
Sulfur dioxide	3 hours	0.5 ppm	S
	24 hours	0.14 ppm	P
	Annual	0.03 ppm	P

[1] ppm = parts per million; mg/m3 = milligrams per cubic meter; µg/m^3 = micrograms per cubic meter
[2] P = primary standard (health-based); S = secondary standard (welfare-based)
Source: 40 CFR, Part 50

The US has been divided into air management units that have been classified based on their status in attaining the National Ambient Air Quality Standards. In an area where ambient concentrations of a particular pollutant are below the National Ambient Air Quality Standards, the US EPA designates that area as being in attainment. Likewise, areas are designated as being in nonattainment if criteria pollutant concentrations violate the National Ambient Air Quality Standards. Formerly nonattainment areas that are now in compliance with the National Ambient Air Quality Standards are designated as maintenance areas. Nonattainment areas must implement a plan to reduce ambient concentrations below the National Ambient Air Quality Standards. Areas where insufficient data are available to determine attainment status are designated as unclassified and are treated as attainment areas for regulatory purposes.

In addition to criteria pollutants, the US EPA, together with the states, also controls air toxics, or hazardous air pollutants. Such substances, if present in the surrounding air, are thought to have serious health impacts. Lists of substances identified as air toxics have been issued by the US EPA and some individual states. The details of the list and regulations applied to the hazardous air pollutants may vary among jurisdictions. Due to its minute emissions, an operating geothermal energy development would most likely be exempt from air toxics emissions regulations, depending on the types of technology and local attainment status.

3.8.3 Attainment Status in the Project and Planning Areas

Existing air quality conditions across the project and planning areas are described in terms of attainment status. Ambient pollutant levels are expected to be low in the undeveloped regions of public and NFS lands and negligible in remote areas. Project and planning areas with high pollutant levels are typically those with either large amounts of human development or high winds and dusty soil types with little vegetation.

Counties in the project and planning areas with public or NFS lands that are designated as nonattainment or maintenance areas for each criteria pollutant are listed in Table 3-13. Levels of PM_{10}, ozone, and nitrogen dioxide are expected to be higher near industrial areas and cities, which are associated with greater fossil fuel combustion. High sulfur dioxide concentrations are most commonly observed in areas with coal-fired power plants, smelters, and refineries.

Table 3-13
Project Area Counties that are Designated Nonattainment or Maintenance Areas for Criteria Pollutants

Pollutant	State	Nonattainment (Project Area)	Nonattainment (Planning Area)	Maintenance (Project Area)	Maintenance (Planning Area)
PM_{10}	AK	Anchorage Municipality[1], Juneau City and Borough[1]	None	None	None
	AZ	Pima[1], Gila[1], Pinal[1], Santa Cruz[1], Cochise[1], Maricopa[1], Yuma[1]	Pima[1], Gila[1], Pinal[1], Santa Cruz[1], Cochise[1], Maricopa[1], Yuma[1]	Mohave[1], Gila[1]	Mohave[1], Gila[1]
	CA	Riverside[1], Inyo[1], Imperial[1], Los Angeles[1], Orange, Riverside[1], San	Riverside[1], Inyo[1], Imperial[1], Los Angeles[1], Orange, Riverside[1], San	Kern[1]	Kern[1]

Table 3-13
Project Area Counties that are Designated Nonattainment or Maintenance Areas for Criteria Pollutants

Pollutant	State	Nonattainment (Project Area)	Nonattainment (Planning Area)	Maintenance (Project Area)	Maintenance (Planning Area)
		Bernardino[1], Mono[1], Inyo[1], Sacramento, Kern[1], Kings[1], Madera[1], San Joaquin[1], Stanislaus[1], Tulare[1],	Bernardino[1], Mono[1], Inyo[1], Sacramento, Kern[1], Kings[1], Madera[1], San Joaquin[1], Stanislaus[1], Tulare[1],		
	CO	None	None	Pitkin[1], Fremont[1], Adams[1], Araphoe[1], Boulder[1], Broomfield, Denver, Douglas, Jefferson, Prowers[1], Archuleta[1], Routt[1], San Miguel[1]	Pitkin[1], Fremont[1], Adams[1], Araphoe[1], Boulder[1], Denver, Douglas, Jefferson, Prowers[1], Archuleta[1], Routt[1], San Miguel[1]
	ID	Bonner[1], Bannock[1], Power[1], Shoshone[1]	Bannock[1], Power[1]	Ada[1], Bannock[1], Power[1]	Ada[1], Bannock[1], Power[1]
	MT	Silver Bow[1], Flathead[1], Rosebud[1], Lincoln[1], Missoula[1], Lake[1], Sanders[1]	Silver Bow[1], Rosebud[1], Lincoln[1], Missoula[1], Sanders[1]	None	None
	NV	Clark[1], Washoe[1],	Clark[1], Washoe[1]	None	None
	NM	Dona Ana[1]	Dona Ana[1]	None	None
	OR	Lane[1]	Lane[1]	Josephine[1], Klamath[1], Union[1], Lake[1], Jackson[1]	Klamath[1], Union[1], Lake[1], Jackson[1]
	UT	Weber[1], Salt Lake, Utah	Weber[1], Salt Lake, Utah	None	None
	WA	None	None	King[1], Thurston[1], Pierce[1], Spokane[1], Walla Walla[1], Yakima[1]	King[1], Thurston[1], Pierce[1], Walla Walla[1], Yakima[1]
	WY	Sheridan[1]	Sheridan[1]	None	None
Sulfur Dioxide	AZ	Pinal[1]	Pinal[1]	Pima[1], Cochise[1], Gila[1], Greenlee[1]	Pima[1], Cochise[1], Gila[1], Greenlee[1]
	MT	Lewis and Clark[1], Yellowstone[1]	Lewis and Clark[1], Yellowstone[1]	None	None
	NV	None	None	White Pine[1]	White Pine[1]
	NM	None	None	Grant[1]	Grant[1]
	UT	Salt Lake, Tooele[1]	Salt Lake, Tooele[1]	None	None

Table 3-13
Project Area Counties that are Designated Nonattainment or Maintenance Areas for Criteria Pollutants

Pollutant	State	Nonattainment (Project Area)	Nonattainment (Planning Area)	Maintenance (Project Area)	Maintenance (Planning Area)
Nitrous Dioxide	--	None	None	None	None
Carbon Monoxide	AK	None	None	Anchorage Municipality[1], Fairbanks North Star Borough[1]	Fairbanks North Star Borough[1]
	AZ	None	None	Maricopa[1], Pima[1]	Maricopa[1], Pima[1]
	CA	None	None	Kern[1], Butte[1], Fresno[1], Placer[1], El Dorado[1], Los Angeles[1], Orange, Riverside[1], San Bernardino[1], Stanislaus[1], Sacramento[1], Yolo[1], San Diego[1], Alameda[1], Contra Costa[1], Marin[1], Napa[1], San Francisco[1], San Mateo[1], Santa Clara[1], Solano[1], Sonoma[1], San Joaquin[1]	Kern[1], Butte[1], Fresno[1], Placer[1], El Dorado[1], Los Angeles[1], Orange, Riverside[1], San Bernardino[1], Stanislaus[1], Sacramento[1], Yolo[1], San Diego[1], Alameda[1], Contra Costa[1], Marin[1], Napa[1], San Francisco[1], San Mateo[1], Santa Clara[1], Solano[1], Sonoma[1], San Joaquin[1]
	CO	None	None	El Paso[1], Teller[1], Adams[1], Araphoe[1], Boulder[1], Broomfield, Denver, Douglas[1], Jefferson[1], Larimer[1], Weld[1], Boulder[1], Weld[1]	El Paso[1], Teller[1], Adams[1], Araphoe[1], Boulder[1], Denver, Douglas[1], Jefferson[1], Larimer[1], Weld[1]
	ID	None	None	Ada[1]	Ada[1]
	MT	Missoula[1]	Missoula[1]	Yellowstone[1], Cascade[1]	Yellowstone[1]
	NV	Clark[1], Washoe[1]	Clark[1], Washoe[1]	Carson City[1], Douglas[1], Washoe[1]	Carson City[1], Douglas[1], Washoe[1]

Table 3-13
Project Area Counties that are Designated Nonattainment or Maintenance Areas for Criteria Pollutants

Pollutant	State	Nonattainment (Project Area)	Nonattainment (Planning Area)	Maintenance (Project Area)	Maintenance (Planning Area)
	NM	None	None	Bernalillo	Bernalillo
	OR	Marion[1], Polk[1]	Marion[1], Polk[1]	Lane[1], Josephine[1], Klamath[1], Jackson[1], Clackamas[1], Multnomah[1], Washington[1]	Lane[1], Klamath[1], Jackson[1], Clackamas[1], Multnomah[1], Washington[1]
	UT	None	None	Weber[1], Utah[1], Salt Lake[1]	Weber[1], Utah[1], Salt Lake[1]
	WA	None	None	King[1], Pierce[1], Snohomish, Spokane[1], Clark[1], Yakima[1]	King[1], Pierce[1], Snohomish, Clark[1], Yakima[1]
Ozone	AZ	Maricopa[1], Pinal[1]	Maricopa[1], Pinal[1]	None	None
Ozone	CA	Amador, Calaveras, Butte[1], Imperial[1], Kern[1], Los Angeles[1], Orange[1], Riverside[1], San Bernardino[1], Mariposa, Tuolumne, Nevada, El Dorado[1], Placer[1], Sacramento[1], Solano[1], Sutter[1], Yolo[1], San Diego[1], Alameda[1], Contra Costa[1], Marin[1], Napa[1], San Francisco[1], San Mateo[1], Santa Clara[1], Solano[1], Sonoma[1], Fresno[1], Kings[1], Madera[1], Merced[1], San Joaquin[1], Stanislaus[1], Tulare[1], Sutter[1], Ventura[1]	Butte[1], Imperial[1], Kern[1], Los Angeles[1], Orange[1], Riverside[1], San Bernardino[1], Nevada, El Dorado[1], Placer[1], Sacramento[1], Solano[1], Yolo[1], San Diego[1], Alameda[1], Contra Costa[1], Marin[1], Napa[1], San Francisco[1], San Mateo[1], Santa Clara[1], Solano[1], Sonoma[1], Fresno[1], Kings[1], Madera[1], Merced[1], San Joaquin[1], Stanislaus[1], Tulare[1], Ventura[1]	None	None
Ozone	CO	Adams[1], Araphoe[1], Boulder[1], Broomfield[1], Denver[1], Douglas[1], Jefferson[1], Larimer[1], Weld[1]	Adams[1], Araphoe[1], Denver[1], Douglas[1], Jefferson[1], Larimer[1], Weld[1]	None	None
Ozone	NV	Clark[1]	Clark[1]	None	None
Lead	MT	Lewis and Clark[1]	Lewis and Clark[1]	None	None

[1] only a portion of the county is in nonattainment

Source: US EPA 2007b

3.8.4 National Air Quality and Emissions Trends

Air quality based on concentrations of the criteria pollutants has improved nationally since 1980. Such trends are observed by using measurements from air quality monitoring stations located across the country. The US EPA expects the long-term trend of air quality improvement to continue as the Clean Air Mercury Rule, state plans to attain national air quality standards, and other national programs and clean air requirements targeting mobile sources are implemented (US EPA 2007a).

The US EPA also estimates nationwide emissions of ambient air pollutants and the pollutants they are formed from (their precursors). Such estimates are based on actual monitoring data or engineering calculations of the amounts and types of pollutants emitted by vehicles, factories, and other sources. Many factors are taken into consideration when calculating emissions estimates, including levels of industrial activity, technological developments, fuel consumption, vehicle miles traveled, and other activities that cause air pollution (US EPA 2007a). While emissions are trending downwards, human-caused air pollutants are still directly connected a number of air quality issues. It is estimated that 137 million tons of pollution are emitted into the atmosphere each year nationwide. These emissions mostly contribute to the formation of ozone and particles, the deposition of acids, and visibility impairment (US EPA 2007a).

3.8.5 Climate Change

Ongoing scientific research has identified the potential impacts of anthropogenic (manmade) greenhouse gas (GHG) emissions and changes in biological carbon sequestration due to land management activities on global climate. Through complex interactions on a regional and global scale, these GHG emissions and net losses of biological carbon sinks cause a net warming effect of the atmosphere, primarily by decreasing the amount of heat energy radiated by the earth back into space. Although GHG levels have varied for millennia, recent industrialization and burning of fossil carbon sources have caused CO2(e) concentrations to increase dramatically and are likely to contribute to overall global climatic changes. The Intergovernmental Panel on Climate Change (IPCC) recently concluded that "warming of the climate system is unequivocal" and "most of the observed increase in globally average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations."

Global mean surface temperatures have increased nearly 1.8°F from 1890 to 2006. Models indicate that average temperature changes are likely to be greater in the Northern Hemisphere. Northern latitudes (above 24° N) have exhibited temperature increases of nearly 2.1°F since 1900, with a nearly 1.8°F increase since 1970 alone. Without additional meteorological monitoring systems, it is difficult to determine the spatial and temporal variability and change of climatic conditions, but increasing concentrations of GHGs are likely to accelerate the rate of climate change.

In 2001, the IPCC indicated that by the year 2100, global average surface temperatures would increase 2.5 to 10.4°F above 1990 levels. The National Academy of Sciences has confirmed these findings, but also has indicated there are uncertainties regarding how climate change may affect different regions. Computer model predictions indicate that increases in temperature will not be equally distributed, but are likely to be accentuated at higher latitudes. Warming during the winter months is expected to be greater than during the summer, and increases in daily minimum temperatures is more likely than increases in daily maximum temperatures. Increases in temperatures would increase water vapor in the atmosphere and reduce soil moisture, increasing generalized drought conditions, while at the same time enhancing heavy storm events. Although large-scale spatial shifts in precipitation distribution may occur, these changes are more uncertain and difficult to predict.

As with any field of scientific study, there are uncertainties associated with the science of climate change. This does not imply that scientists do not have confidence in many aspects of climate change science. Some aspects of the science are known with virtual certainty, because they are based on well-known physical laws and documented trends (EPA 2008).

Several activities contribute to the phenomena of climate change, including emissions of GHGs (especially carbon dioxide and methane) from fossil fuel development, large wildfires, and activities using combustion engines; changes to the natural carbon cycle; and changes to radiative forces and reflectivity (albedo[1]). It is important to note that GHGs will have a sustained climatic impact over different temporal scales. For example, recent emissions of carbon dioxide can influence climate for 100 years.

Information is not available to reasonably discern whether global climate change is already affecting resources within the planning areas. Projected changes are likely to occur over several decades to a century; therefore, many of the projected changes associated with climate change described below may not be measurably discernable within the reasonably foreseeable future.

[1] Changes in reflectivity (albedo) and related effects on climate are not discussed beyond this point. This is in part due to the fact that understanding is limited as to the relationship between albedo and climate change. In addition, the great variability in existing albedo across the planning area renders a programmatic discussion useless; without site- and project-specific information, albedo impacts are not determinable. For example, only if one were to know that a particular geothermal project would result in deforestation of a densely vegetated area and would expose light-colored soil or gravel roads would one know that albedo would be likely to increase. Similarly, only where one knew that a project would involve the laying of black asphalt in a desert environment would one know that albedo would likely decrease.

Existing and anticipated effects of climate change on resources in the planning area are incorporated into the relevant sections below. The following resources have been or are anticipated to be affected by climate change:

- Soil resources;
- Water resources;
- Vegetation;
- Fish and wildlife;
- Threatened and endangered species;
- Wild horses and burros (through changes in vegetation and soil);
- Livestock grazing (through changes in vegetation and soil); and
- Tribal interests (through changes in vegetation and soil and their effects on availability of traditionally used plants).

3.8.6 Typical Emissions Associated with Geothermal Energy

Air emissions from geothermal power plants are very small compared to emissions from fossil fuel plants. Geothermal plants emit small amounts of nitrogen oxides and carbon dioxide and nearly no sulfur dioxide or particulate matter (Geothermal Energy Association 2007b). The primary pollutant of geothermal power plants is hydrogen sulfide, which is naturally present in most geothermal reservoirs. Hydrogen sulfide emissions are maintained below the most stringent standards with the use of sophisticated abatement equipment. Studies carried out in the past few decades estimating emissions from geothermal power plants have concluded that geothermal energy emissions are small and have been reduced by advanced technologies and energy-saving techniques.

Steam from a geothermal plant is condensed when passing through a turbine; however, noncondensable gases in the reservoir fluid such as carbon dioxide, hydrogen sulfide, sulfur dioxide, mercury, and several others pass through the turbine without condensing and are released into the atmosphere. The amount of noncondensable gases present and emitted depends on factors such reservoir fluid composition, temperature, method of power generation (flash, binary, or combined cycle), and equipment efficiency (Bloomfield et al. 2003).

Carbon Dioxide

Carbon dioxide is a noncondensable gas present in geothermal fluids. Of the five percent noncondensable gases present in geothermal steam, 75 percent or more of that volume is occupied by carbon dioxide. The amount of carbon dioxide in the geothermal fluid depends on the location of the reservoir, and the amount released into the atmosphere depends on the technology used by the power plant. For example, geothermal fluids in a closed-loop binary plant are never exposed to the atmosphere and emit no carbon dioxide. Additionally, improved and increased injection technologies have resulted in lower carbon dioxide emissions from geothermal power plants. Such variation in fluid composition and integrated technology makes it difficult to make generalizations about the amount of carbon dioxide released by geothermal plants but one estimate is at 0.20 pounds per kilowatt hour. This estimate weighted average values of all geothermal power plants, including binary plants, which represent 14 percent of the total capacity. This estimate is comparable to the value reported by the Executive Director of the International Geothermal Association, which is approximately 0.29 pounds per kilowatt hour for 85 geothermal plants operating in 11 countries (Bloomfield et al. 2003).

As shown in Table 3-14, geothermal energy production produces between 10 to 15 percent the carbon dioxide emissions that are realized from fossil fuel energy sources.

Table 3-14
Comparison of Geothermal and Fossil Fuel Carbon Dioxide Emissions for Electrical Generation

	Geothermal	Coal	Petroleum	Natural Gas
Emissions (pounds carbon dioxide per kilowatt hour)	0.20	2.095	1.969	1.321

Source: Bloomfield et al. 2003

Hydrogen Sulfide

Of all geothermal power plant emissions, hydrogen sulfide emissions are of greatest concern. Hydrogen sulfide is considered a nuisance pollutant and may be lethal in high doses. Because of such concerns, hydrogen sulfide emissions have been thoroughly studied, and abatement technology has been extensively researched and effectively employed. Abatement systems such as Streford and LO-CAT convert more than 99.9 percent of the hydrogen sulfide from geothermal gases to elemental sulfur, resulting in hydrogen sulfide being reduced to approximately 1 percent of noncondensable gases emitted by geothermal power plants. Binary geothermal power plants do not emit any hydrogen sulfide, while steam and flash power plants produce minimal hydrogen sulfide emissions. A study done by Tiangco et al. in 1995 compared emissions from all types of geothermal power plants, and reported an average hydrogen sulfide emission of 0.29 pounds per megawatt hour for dual-flash plants. In this report, the authors point out that hydrogen sulfide emission from California geothermal plants are measured below the limits set by the state's air pollutions control districts, which are often below federal standards. Considering all types of geothermal power plants, hydrogen sulfide emissions average was reported around 0.187 pounds per megawatt hour (Bloomfield et al. 2003).

Sulfur Dioxide

Geothermal plants do not emit sulfur dioxide directly, but hydrogen sulfide emissions eventually form sulfur dioxide in the atmosphere. These indirect sulfur dioxide emissions from flash geothermal plants are measured at 0.35 pounds per megawatt hour (Geothermal Energy Association 2007b).

Particulate Matter

Particulate matter is of little concern in geothermal plants, as emissions are measured well below federal limits. The Geothermal Energy Association (2007b) reviewed a 1995 study that reported PM_{10} emissions from California geothermal plants at zero. Small amounts of particulate matter are emitted from water-cooled geothermal plants, but these emissions are well below federal limits and are quite small compared to emissions from coal or oil plants (Geothermal Energy Association 2007b).

Nitrogen Oxides

Nitrogen oxides form from nitrogen oxidation in the air during high-temperature burning processes such as fuel burning. Geothermal power plants do not burn any fuel; therefore, they emit zero or low amounts of nitrogen oxides. Average nitrogen oxide emissions are reported at zero, yet some geothermal plants do emit small amounts of nitrogen oxides through combustion of hydrogen sulfide in hydrogen sulfide abatement systems.

3.9 VEGETATION

Vegetation is a general term for the plant life of a region; it refers to the ground cover provided by plants and is the most abundant biotic element of the biosphere. The term vegetation does not by itself imply anything regarding species composition, life forms, structure, spatial extent, or any other specific botanical or geographic characteristics. Old-growth redwood forests, sagebrush scrub, sphagnum bogs, desert soil crusts, roadside weed patches, and cultivated farmlands are all encompassed by the term vegetation.

Vegetation serves several critical ecological functions. Vegetation regulates the flow of water, carbon, and nitrogen. It is also of great importance in local and global energy cycles, the process by which energy from the sun is captured and redistributed among plants and animals and may be eventually stored as fossil fuels or released as heat energy. Such cycles are important not only for global vegetation patterns, but also for global climate patterns. Vegetation strongly affects soil characteristics, including soil volume, chemistry, and texture, which feed back to affect various vegetation characteristics, including productivity and structure. Also, vegetation serves as wildlife habitat and a food energy source for animal species (and, ultimately, to those that prey upon them). Vegetation is also critically important to the world economy in the global production of food, wood, fuel and other materials. Vegetation is the primary source of the earth's atmospheric oxygen.

Vegetation as discussed in this section includes everything from mosses and annual grasses to large trees. This section will introduce vegetation types across the western US and discuss vegetation type (tree, shrub, herb), life history (evergreen, deciduous, annual, perennial), percent canopy cover, and hydrologic and climactic requirements.

Vegetative communities occurring within the project area span a great variety of ecosystems, from arid deserts to coastal coniferous forests. Each vegetative community is unique in species composition, richness, diversity, and structure. A wide range of environmental factors influence the presence and development of various types of vegetation throughout the project area, including climate, elevation, aspect, precipitation, and soil type. Because of the great variety and complexity of project area vegetation, the project area can best be represented by ecoregions.

3.9.1 Ecoregions

Ecoregions are large areas of similar climate where ecosystems recur in predictable patterns. Each ecoregion contains a geographically distinct assemblage of natural vegetation and wildlife communities and species. Ecoregions are separated by a hierarchy that groups very large areas together based on climate, similarities in plant occurrence and abundance, soil type, climate, altitude, and precipitation, among other factors (Bailey 1988).

The largest ecosystems are domains. Domains are large areas of related climate differentiated based on precipitation and temperature. There are three domains in the project area: Polar, Dry, and Humid Temperate.

Divisions represent the climates within domains and are differentiated based on precipitation levels and patterns, as well as temperature (Figures 3-10 and 3-11). Ten divisions comprise the project area.

Divisions are subdivided into provinces, which are differentiated based on vegetation or other natural land covers. Provinces in each division are also divided into mountain and non-mountain provinces based on altitude. Twenty-nine provinces make up the project area (Figures 3-12 and 3-13). Table 3-15 lists the domains, divisions and respective provinces found in the project area. Ecoregions are further divided into sections and subsections. Appendix G provides more detail on ecoregions.

Table 3-15
Project Area Ecoregions and Subregions

Domain	Division	Province
Polar	Arctic	Arctic Tundra Brooks Range Tundra Bering Sea Tundra
	Subarctic	Yukon Intermountain Taiga Upper Yukon Taiga Alaska Range Taiga
Humid Temperate	Warm Continental	Alaska Mixed Forest
	Cold Oceanic	Aleutian Meadow
	Marine	Pacific Lowland Mixed Forest Cascade Mixed Forest Pacific Coastal Icefields Pacific Gulf Coast Forest
	Mediterranean	California Coastal Chaparral Forest Shrub California Dry Steppe California Coastal Steppe, Mixed Forest, and Redwood Forest Sierran Steppe—Mixed Forest—Coniferous Forest—Alpine Meadow California Coastal Range Open Woodland—Shrub—Coniferous Forest—Meadow

Table 3-15
Project Area Ecoregions and Subregions

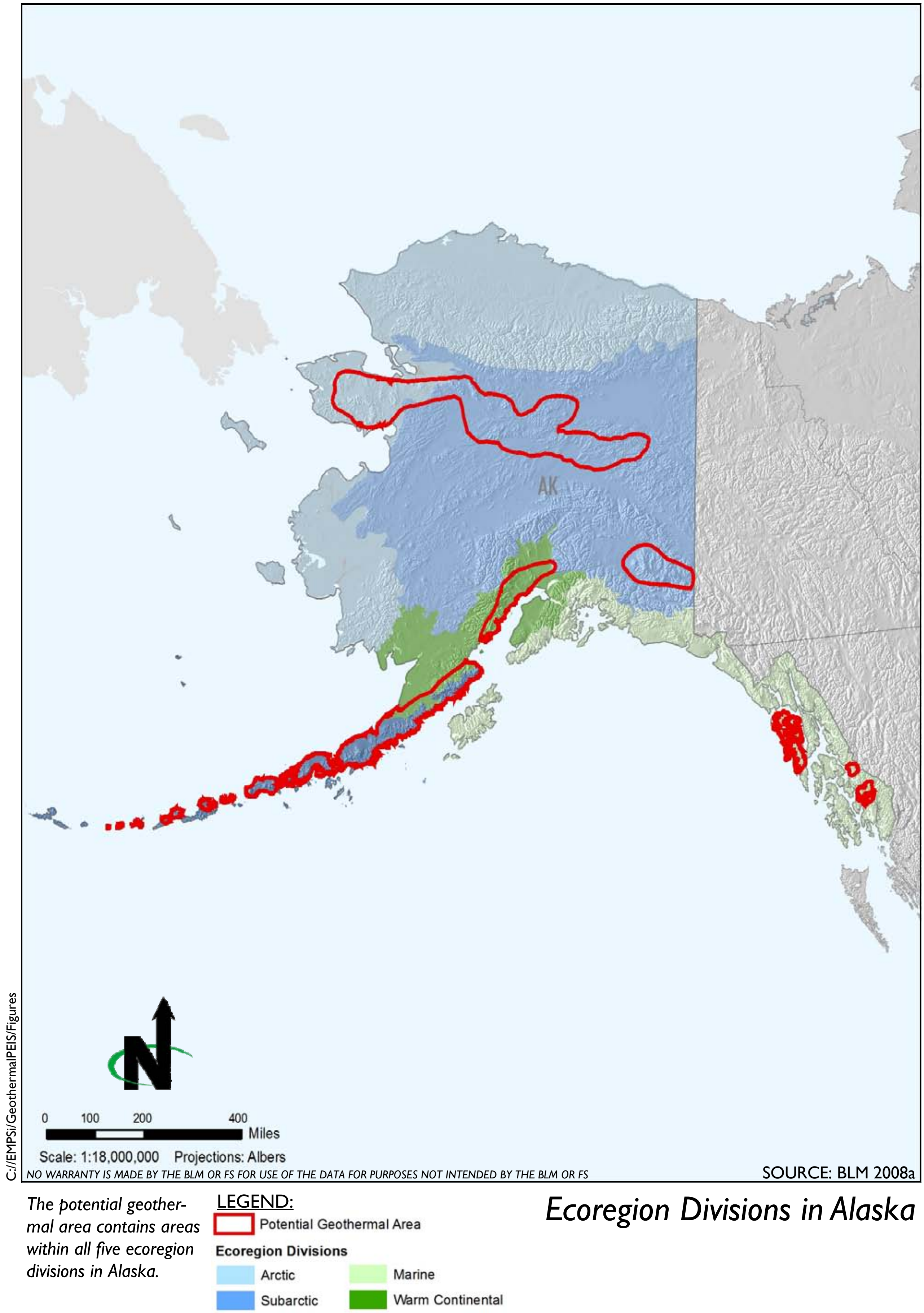
Domain	Division	Province
Dry	Tropical/Subtropical Steppe	Colorado Plateau Semidesert Southwest Plateau and Plains Dry Steppe and Shrub Arizona-New Mexico Mountains Semidesert—Open Woodland—Coniferous Forest—Alpine Meadow
	Tropical/Subtropical Desert	Chihuahuan Semidesert American Semidesert and Desert
	Temperate Steppe	Great Plains- Palouse Dry Steppe Southern Rocky Mountain Steppe—Open Woodland—Coniferous Forest—Alpine Meadow Middle Rocky Mountain Steppe—Coniferous Forest—Alpine Meadow Northern Rocky Mountain Forest-Steppe—Coniferous Forest—Alpine Meadow
	Temperate Desert	Intermountain Semidesert Nevada-Utah Mountains Semidesert—Coniferous Forest—Alpine Meadow Intermountain Semidesert and Desert

Source: Nowacki and Brock 1995, Bailey 1983,

Many federal agencies and private organizations, including the FS, BLM, US EPA, USGS, USFWS, Nature Conservancy, and Sierra Club, use a land classification system based on the ecoregion concept. Projects include biodiversity analysis and landscape- and regional-level forest and habitat planning. General vegetation trends are outlined below for each project area ecoregion division.

Arctic Division

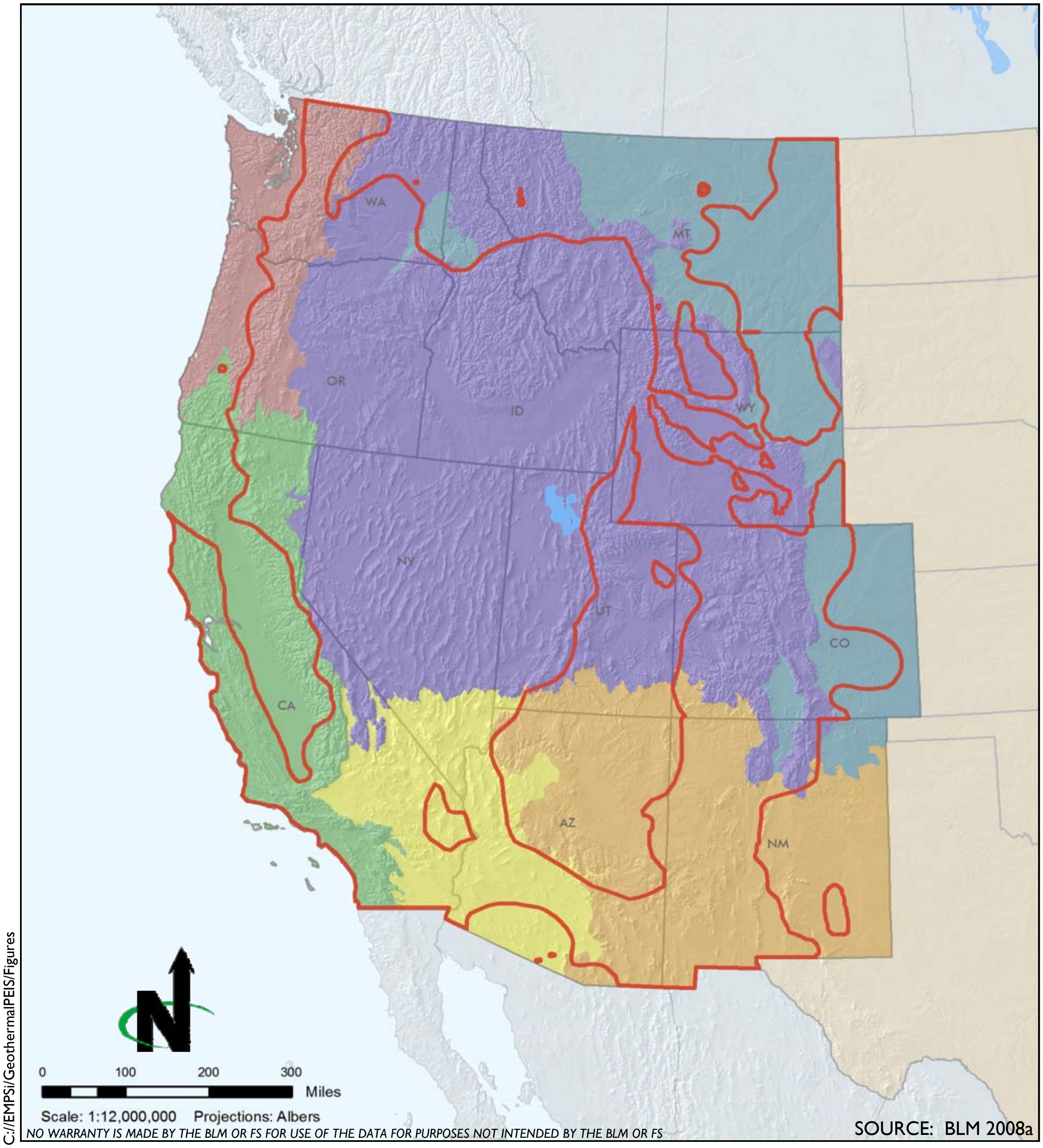
The Arctic Division occurs primarily in northern and western Alaska bordering the Bering Sea (Figure 3-10). The arctic division is best described as tundra. Vegetation consists of grasses, sedges, lichens, and willow shrubs. Moving south, the vegetation changes into birch-lichen woodland, and then into needleleaf forest. A distinct tree line separates forest from tundra in some places. This line coincides approximately with the 50 degrees F isotherm for the warmest month and is the boundary between tundra and subarctic climates (Bailey 1983). Moist and wet tundra communities provide the dominant vegetation. Standing water, mosses, sedges, and low-growing shrubs cover most of the area. Alder, willows, and scattered stands of stunted spruce and birch grow along the major rivers and streams.



The potential geothermal area contains areas within all five ecoregion divisions in Alaska.

Ecoregion Divisions in Alaska

Figure 3-10

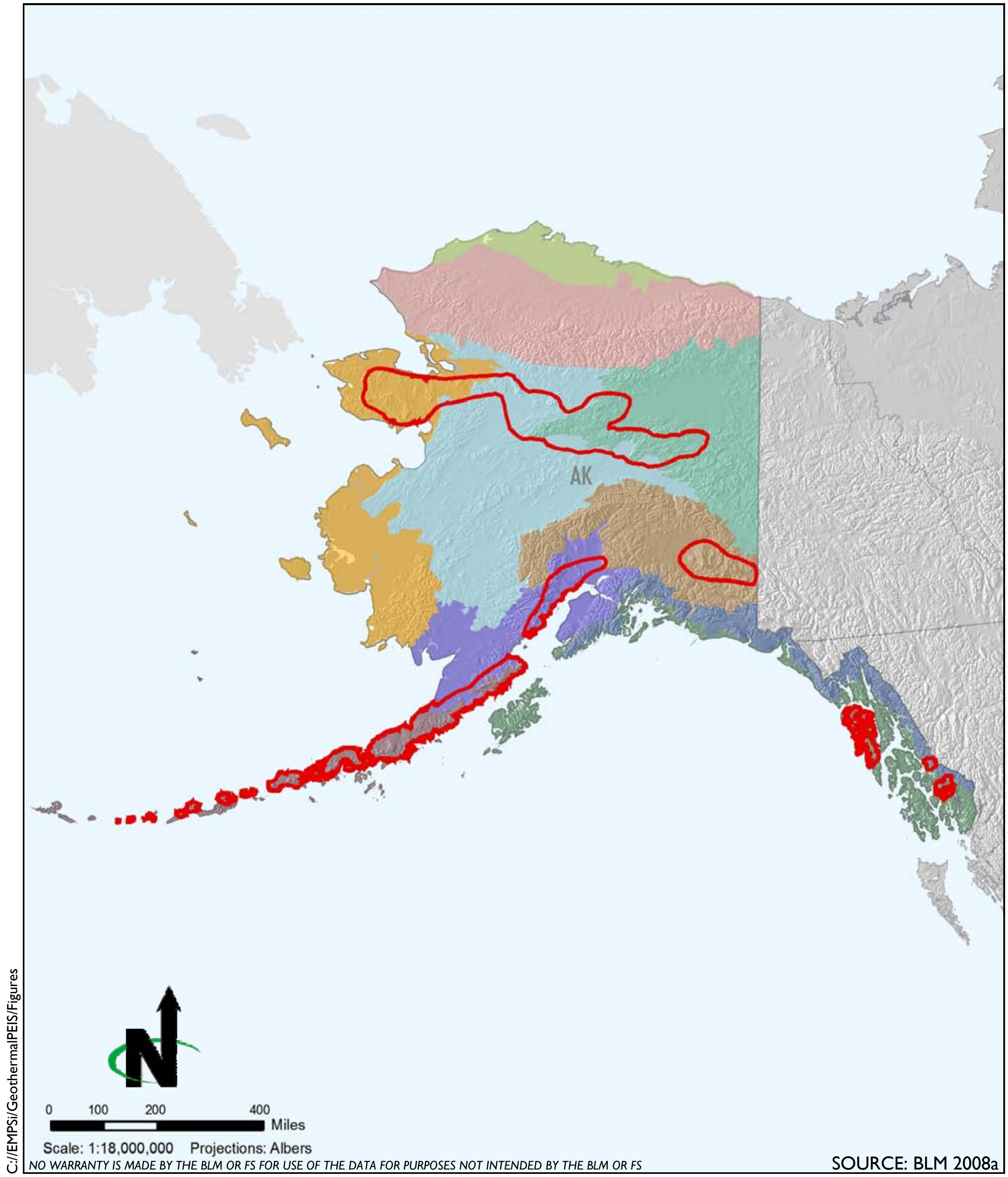


Areas of geothermal potential are found in all six ecoregion divisions of the 11 western states.

LEGEND:
Potential Geothermal Area
Ecoregions
Marine
Mediterranean
Temperate Desert
Temperate Steppe
Tropical/Subtropical Desert
Tropical/Subtropical Steppe

Ecoregion Divisions in the 11 Western States

Figure 3-11



Potential geothermal area is found within eight of the ten ecoregion provinces in Alaska.

LEGEND:

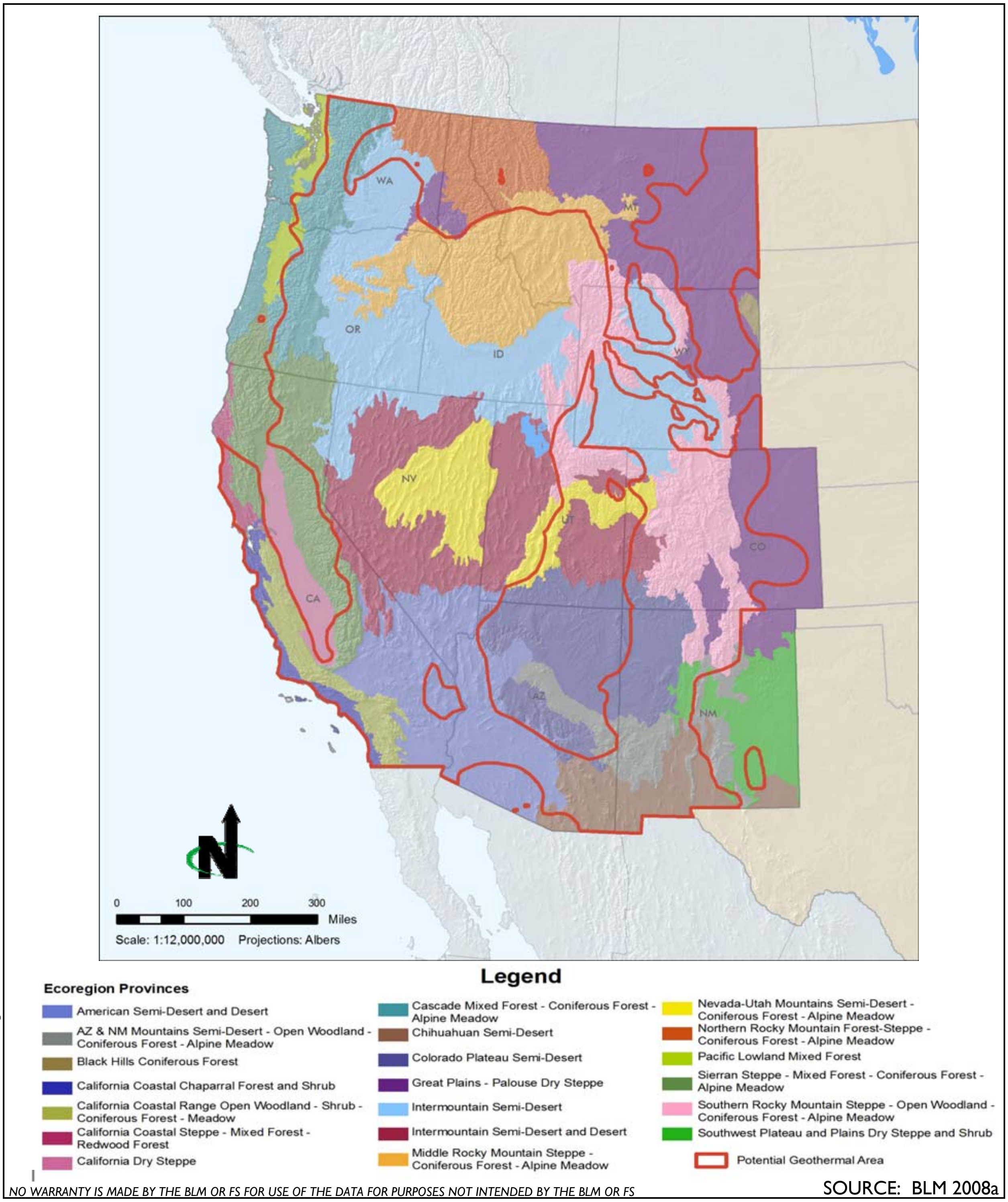
Potential Geothermal Area

Ecoregion Provinces

Bering Sea Tundra Province	Aleutian Meadow Province
Upper Yukon Taiga Province	Pacific Gulf Coast Forest Province
Alaska Range Taiga Province	Alaska Mixed Forest Province
Yukon Intermountain Taiga Province	Arctic Tundra Province
Pacific Coastal Icefields Province	Brooks Range Tundra Province

Ecoregion Provinces in Alaska

Figure 3-12



C://EMPSi/GeothermalPEIS/Figures

The 11 Western States are divided into 20 ecoregion provinces.

Ecoregion Provinces in the 11 Western States

Figure 3-13

In the coldest area, permafrost limits the rooting depth of plants and forces surface water to drain by preventing it from seeping into the soil. Extensive marshes and lakes result. Cottongrass-tussock, the most widespread vegetation system in the Arctic, is associated with sedges, dwarf shrubs, lichens, mosses, dwarf birch, Labrador-tea, and cinquefoil. These highly productive systems produce 500 to 1,000 pounds of vegetation per acre and provide an important source of food for caribou and waterfowl. Several forbs flower brightly in the short summer.

Vegetation along the wet coastal areas is chiefly sedge and cottongrass; woody plants grow on higher sites. Birch-willow-alder thickets are extensive in transition zones between beach and forest. The lower Yukon and Kuskokwim Valleys are dominated by white spruce mixed with cottonwood and balsam poplar in tall, relatively dense stands, with a dense undergrowth of thinleaf alder, willow, rose, dogwood, and various species of berry bushes.

Subarctic Division

The Subarctic Division occurs primarily in central Alaska and includes much of the Brooks Range and the Yukon River watershed (Figure 3-10). The subarctic climate zone coincides with a great belt of needleleaf forest, often referred to as boreal forest, and with open lichen woodland known as tiaga. The tiaga forests are largely coniferous and are dominated by larch, spruce, fir, and pine. Although the taiga is dominated by coniferous forests, some broadleaf trees also occur, notably birch, aspen, willow, and rowan. Many smaller herbaceous plants grow closer to the ground.

The major river bottoms support dense white spruce-cottonwood-poplar forests on floodplains and south-facing slopes up to approximately 1,000 feet. The undergrowth is dense shrubbery formed by green and thinleaf alder, willow, dogwood, and berries. The outer valley edges support evergreen and coniferous forests, often with pure stands of black spruce. The undergrowth consists of willow, dwarf birch, crowberry, fern, blueberry, lichens, and mosses. Upland areas are generally covered by a rather dense white spruce-birch-aspen-poplar forest. Pure stands of white spruce grow near streams. Typical undergrowth includes willow, alder, fern, berries, grasses, and mosses. Root systems are shallow. Water balance is likely the factor limiting growth in most of these areas because of the hot, dry summer climate. Old river terraces, ponds, and sloughs contain scattered but extensive bogs where the vegetation is chiefly sphagnum and other mosses, sedges, bog rosemary, and Labrador-tea. Marginal areas may support willow and alder.

Cold Oceanic

The Cold Oceanic division includes much of the Alaska Peninsula and all of the Aleutian Islands. The islands that chiefly make up this province are mountainous, rising steeply from the sea. Trees are absent from the division and vegetation consists of low shrubs of willow, birch, and alder interspersed with lichen, and grass communities. At lower elevations, there is a luxuriant growth of tall grasses, flowering plants, and ferns, with thickets of low willows in some places. A little higher up, several types of heath cover vast areas. The boreal forest and coastal rainforest are slowly encroaching from the east on the area of this province. This is explained by the assumption that the distribution of the vegetation is not yet adjusted to the climatic conditions produced by retreat of the last continental glaciers Alpine tundra is found on mountainsides.

Warm Continental

The Warm Continental Division occurs in coastal areas of southwest Alaska, including part of the Kenai and Alaska peninsulas (Figure 3-10). Moist and wet tundra communities provide the dominant vegetation at the western edge near the coast. Standing water, mosses, sedges, and low-growing shrubs cover most of the area. Alder, willows, and scattered stands of stunted spruce and birch grow along the major rivers and streams. Further to the east and inland vertical vegetational zonation characterizes the Alaska Range and Wrangell Mountains, beginning with dense bottom-land stands of white spruce and cottonwood on the floodplains and low terraces of the Copper and Susitna Rivers. Above the terraces, poorly drained areas up to 1,000 feet support stands of black spruce. Upland spruce-hardwood forests of white spruce, birch, aspen, and poplar, with an undergrowth of moss, fern, grass, and berry, extend to timberline at about 2,500-3,500 feet. Tundra systems of low shrubs and herbaceous plants form discontinuous mats among the rocks and rubble above timberline. White mountain-avens may cover entire ridges in the Alaska Range, associated with moss campion, black oxytrope, arctic sandwort, lichens, grasses, and sedges. These tundra systems stop short of the permanent ice caps on the highest peaks.

Marine Division

The Marine Division occurs primarily in coastal areas from the Gulf of Alaska, including the Alaska panhandle, Kenai Peninsula, and Kodiak Island, to the Oregon border (Figures 3-10 and 3-11). Much of this division was heavily logged. Prior to extensive logging, dense coniferous forest dominated the vegetation. Principal trees are western redcedar, western hemlock, and Douglas-fir. The coniferous forest found further inland is less dense than along the coast and often contains deciduous trees, such as big-leaf maple, Oregon ash, and black cottonwood. Prairie areas support open stands of oaks or are broken by groves of Douglas-fir and other trees; principal indicator species are Oregon white oak and Pacific madrone. Poorly drained sites with swamp or bog communities are abundant.

The timberline is at low elevations, and much of the mountainous area above it is covered with nearly bare rocks, snowfields, and glaciers. Wherever soil has accumulated, however, there are grasses, herbs, and low shrubs. The timberline varies greatly in elevation, depending on slope exposure and other factors. Near

Prince William Sound, for example, the timberline is usually between 1,000 and 2,000 feet but can drop as low as 500 feet.

Mediterranean Division

The Mediterranean Division covers most of the state of California, with exception of the Mojave Desert and high Sierra Nevada mountains (Figure 3-11). The combination of wet winters and dry summers is unique among climate types. This region's montane vegetation consists of species with thick, hard evergreen leaves. The most important evergreen trees of the sclerophyll forest are California live oak, canyon live oak, interior live oak, tanoak, California laurel, Pacific madrone, golden chinkapin, and Pacific bayberry. The interior valleys have sagebrush and grassland communities. A riparian forest with many broadleaf species grows along streams. The coastal areas are wetter during the summer months and include coast redwoods, Douglas-fir, and other conifers. In the higher-altitude regions, the most important trees are ponderosa pine, Jeffrey pine, Douglas-fir, sugar pine, white fir, red fir, and incense cedar; but several other conifers are also present. The giant sequoia is one of the most spectacular species, but it grows only in a few groves on the western slope. Dense chaparral communities of manzanita, buckbrush, and buckthorn may appear after fire, sometimes persisting for years.

Tropical/Subtropical Steppe Division

The Tropical/Subtropical Steppe Division occurs primarily in the eastern half of Arizona and covers most of New Mexico (Figure 3-11). Steppes typically are grasslands of short grasses and other herbs and are present with locally developed shrub and woodland. On the Colorado Plateau, for example, there is pinyon-juniper woodland. To the east, in Texas, the grasslands grade into savanna woodland or semideserts composed of xerophytic shrubs and trees, and the climate becomes semiarid-subtropical. Cactus plants are present in some places. These areas are able to support limited livestock grazing but are not generally moist enough for crop cultivation without irrigation.

The foothill zone, which reaches as high as 7,000 feet, is characterized by mixed grasses, chaparral brush, oak-juniper woodland, and pinyon-juniper woodland. At about 7,000 feet, open forests of ponderosa pine are found, although pinyon and juniper occupy south-facing slopes. In Arizona, the pine forests of this zone are strongly infused with Mexican species, including Chihuahuan and Apache pine. Pine forest is replaced at about 8,000 feet on north-facing slopes by Douglas-fir. Aspen is common, and limber pine grows in places that are rockier and drier. The Douglas-fir zone merges into a zone of Engelmann spruce and corkbark fir at about 9,000 feet. Limber pines and bristlecone pines grow in rockier places. An alpine belt covers relatively small areas above 11,000 feet.

Tropical/Subtropical Desert Division

The Tropical/Subtropical Desert Division occurs primarily in western Arizona and southeast California and includes the Mojave Desert (Figure 3-11). The region is characterized by dry-desert vegetation, a class of xerophytic plants that are widely dispersed and provide negligible ground cover. In dry periods, visible vegetation is limited to small hard-leaved or spiny shrubs, cacti, or hard grasses. Many species of small annuals may be present, but they appear only after rare but heavy rains have saturated the soil.

In the Mojave-Sonoran Deserts (American Desert), plants are often so large that some places have a near-woodland appearance. Well known are the treelike saguaro cactus, the prickly pear cactus, the ocotillo, creosote bush, and smoke tree. But much of the desert of the southwestern US is in fact scrub, thorn scrub, savanna, or steppe grassland. Parts of this region have no visible plants; they are made up of shifting sand dunes or almost sterile salt flats.

A dominant pedogenic process is salinization, which produces areas of salt crust where only salt-loving (halophytic) plants can survive. Calcification is conspicuous on well-drained uplands, where encrustations and deposits of calcium carbonate (caliche) are common.

Temperate Steppe Division

The Temperate Steppe Division covers the high plains of Colorado, Wyoming, and Nevada (Figure 3-11). The vegetation is steppe, sometimes called shortgrass prairie, and semidesert. Typical steppe vegetation consists of numerous species of short grasses that usually grow in sparsely distributed bunches. Scattered shrubs and low trees sometimes grow in the steppe; all gradations of cover are present, from semidesert to woodland. Because ground cover is generally sparse, much soil is exposed. Many species of grasses and other herbs occur. Buffalo grass is typical of the American steppe; other typical plants are the sunflower and locoweed.

The semidesert cover is a xerophytic shrub vegetation accompanied by a poorly developed herbaceous layer. Trees are generally absent. An example of semidesert cover is the sagebrush vegetation of the middle and southern Rocky Mountain region and the Colorado Plateau.

A striking feature of the region is its pronounced vegetation zonation, controlled by a combination of altitude, latitude, direction of prevailing winds, and slope exposure. Generally, the various zones are at higher altitudes in the southern part of the province than in the northern, and they extend downward on east-facing and north-facing slopes and in narrow ravines and valleys subject to cold air drainage. The uppermost (alpine) zone is characterized by alpine tundra and the absence of trees. Directly below it is the subalpine zone, dominated in most places by Engelmann spruce and subalpine fir. Below this area lies the montane zone, characterized by ponderosa pine and Douglas-fir, which frequently alternate. Ponderosa pine dominates on lower, drier, more exposed slopes, and Douglas-fir is predominant in higher, moister, more-sheltered areas.

Temperate Desert Division

The Temperate Desert Division covers the largest portion of the project area and includes the western half of Colorado, Wyoming, and Montana, as well as most of Utah, Nevada, and portions of eastern Oregon and Washington (Figure 3-11). Sagebrush dominates at lower elevations. Other important plants in the sagebrush belt are shadscale, fourwing saltbush, rubber rabbitbrush, spiny hopsage, and horsebrush. All tolerate alkali to varying degrees, essential to their survival on the poorly drained soils widespread in the region. Where salt concentrations are very high, even these shrubs are unable to grow; they are replaced by plant communities dominated by greasewood or saltgrass.

The woodland belt above the sagebrush zone is similar to the corresponding belt on the Colorado Plateau, with juniper and pinyon occupying lower mountain slopes. The belt is frequently interrupted as mountains give way to plains.

In the montane zone above the woodland belt, ponderosa pine generally occupies the lower and more exposed slopes and Douglas-fir the higher and more sheltered ones. Typical species of the subalpine belt are alpine fir and Engelmann spruce. Great Basin bristlecone pine, with some individuals more than 1,000 years old, occupies widely scattered peaks. Only a few mountains in this province rise high enough to support an alpine meadow belt.

Noxious Weeds and Invasive Vegetation

Noxious weeds are invasive plants that are designated and regulated by state and federal laws, such as the Federal Noxious Weed Act, because they are detrimental to agriculture, commerce, and/or public health, and are recognized as a major threat to ecosystems. Noxious weeds are generally nonnative invasive plants that have been either accidentally or intentionally introduced.

Invasive plants and noxious weeds have biological traits that enable them to colonize new areas and successfully compete with native species. They can transform the structure and function of ecosystems through direct competition; changes in nutrient cycling, succession, and disturbance regimes; and shifts in evolutionary selection pressures (Mack and D'Antonio 1998). The spread of invasive plants threatens the structure and function of many ecosystems worldwide. Certain invasive plant species have the ability to spread over large areas or acutely threaten an ecosystem over its continental range (FS 2003a, Hobbs and Humphries 1995). There are estimated to be over 2,000 species of nonnative plants in the US, over half of which are considered invasive species (US Congress Office of Technology and Assessment 1993).

Invasive plants are introduced through a variety of pathways. Some nonnative species were intentionally introduced for beneficial reasons such as erosion control or as ornamental for gardens and later became invasive. Common methods of introduction and dispersal include contaminated seed, feed grain, hay, straw, and mulch; contaminated equipment movement across uncontaminated lands; contaminated animal fur and fleece; spreading of gravel, roadfill, and topsoil contaminated with noxious weed seed; and plants and seeds sold through nurseries as ornamentals (BLM 1996).

It is estimated that invasive plants already infest well over 40 million acres in the project area, and they continue to spread at an estimated rate of 3 million acres annually (BLM 1998). The estimated rate of weed spread on western NFS and public lands in 1996 was 2,300 acres per day (BLM 1996). A recent estimate of weed spread on all western federal lands is 10 to 15 percent annually (Asher and Dewey 2005). The states with the largest weed infestations on federal lands are Utah, Nevada, Arizona, and Oregon (Table 3-16). The most dominant invasive plants consist of grasses in the *Bromus* genus, which represent nearly 70 percent of the total infested area. The FS and BLM have recently adopted new strategies for managing noxious weeds and invasive vegetation (BLM 2007c, FS 2003b). Weed infestations are capable of destroying wildlife habitat; reducing opportunities for hunting, fishing, camping and other recreational activities; displacing many threatened and endangered species; reducing plant and animal diversity because of weed monocultures; increasing the risks of wildfire; and costing millions of dollars in controls and direct losses to land owners.

Table 3-16
Estimated Acres of Weed Infestation on NFS and Public Lands

State	Acres of Weed Infestations	Total Acreage	Percent Infested
Alaska	992	8,659,908	<0.01
Arizona	8,288,637	11,078,970	74.8
California	1,129,000	28,263,036	4.0
Colorado	3,084,000	22,167,004	13.9
Idaho	3,419,500	29,947,638	11.4
Montana	1,281,553	12,998,695	9.8
New Mexico	48,051	51,555,682	0.04
Nevada	9,257,394	17,758,678	52.1
Oregon and Washington	6,407,113	27,702,159	23.1
Utah	10,286,629	13,506,474	76.1
Wyoming	1,658,500	16,299,068	10.2

Source: Peterson 2006; BLM 1996, 2007c

3.9.2 Important Vegetation Communities

Riparian Areas and Wetlands

Riparian areas are the zones along water bodies that serve as interfaces between terrestrial and aquatic ecosystems. Riparian areas are most commonly associated with river and stream corridors, though riparian vegetation can also be found in marshes, wetlands, and along lakesides. The USDA, Natural Resources Conservation Service defines riparian areas in its General Manual (190-General Manual, Part 411) as "ecosystems that occur along watercourses and water bodies. They are distinctly different from the surrounding lands because of unique soil and vegetation characteristics that are strongly influenced by free or unbound water in the soil. Riparian ecosystems occupy the transitional area between the terrestrial and aquatic ecosystems. Typical examples would include floodplains, stream banks, and lakeshores." The USDA, Natural Resources Conservation Service's indicators of riparian areas include:

- Vegetation – The kinds and amounts of vegetation will reflect the influence of free or unbound water from an associated watercourse or water body and contrast with terrestrial vegetation.
- Soils – Soils in natural riparian areas consist of stratified sediments of varying textures that are subject to intermittent flooding or fluctuating water tables that may reach the surface. The duration of the soil-wetness feature is dependent upon the seasonal meteorological characteristics of the adjacent water body.
- Hydrology – Riparian areas are directly influenced by water from a watercourse or water body. Riparian areas occur along natural watercourses, such as perennial or intermittent streams and rivers, or adjacent to natural lakes. They may also occur along constructed watercourses or water bodies such as ditches, canals, ponds, and reservoirs.

Topography, relief, climate, flooding, and soil deposition most strongly influence the extent of water regimes and associated riparian zones. Likewise, a riparian area exerts considerable control on the flows in the landscape, especially on the movement of water, nutrients, sediments, and animal and plant species. Thus, the appearance and boundary of a riparian area vary from site to site. Riparian areas occur as complete ecosystems or as transition zones between aquatic and terrestrial ecosystems. They are more structurally diverse and more productive in plant and animal biomass than adjacent upland areas.

Riparian areas are critical ecosystem components because they provide wildlife cover, transportation corridors, and foraging and nesting habitat, as well as high plant and wildlife species diversity and density. Riparian areas are important in mitigating or controlling nonpoint source pollution. Riparian vegetation can be effective in removing excess nutrients and sediment from surface runoff and shallow ground water. They also can shade streams to optimize light and temperature conditions for aquatic plants and animals. Riparian vegetation, especially trees, is also effective in stabilizing stream banks and slowing flood flows, resulting in reduced downstream flood peaks (Montgomery 1996). Riparian areas are often important for their recreation and scenic values, such as hunting, fishing, boating, swimming, hiking, camping, picnicking, and bird watching.

Some riparian areas meet the criteria established for wetlands (Cowardin et al. 1979). Others do not because they do not possess the necessary hydrologic water regime, a predominance of hydric soils, or a prevalence of hydrophytic vegetation. Even non wetland riparian areas share many characteristics and functions with wetlands. Table 3-17 provides an estimate of the waterways that would be bordered by wetlands in each project area state.

Riparian ecosystems generally compose a small proportion of the landscape. No known comprehensive national inventory has been completed on the status, conditions, or trends of riparian areas. Local inventories have been conducted to provide information for specific needs. The FS and BLM routinely gather riparian information for activities on NFS and public lands, respectively (Montgomery 1996).

Table 3-17
Estimated Waters with Adjacent Riparian Habitat in the Project Area

State	Estimated River, Stream, and Creek (miles)	Estimated Lake, Pond, and Reservoir (acres)
Alaska	365,990	12,787,200
Arizona	90,375	335,590
California	211,513	2,086,230
Colorado	107,403	164,029
Idaho	115,595	Not available
Montana	176,750	844,802
Nevada	15,549	553,239
New Mexico	110,741	997,467
Oregon	114,823	618,934
Utah	85,916	481,638
Washington	69,204	Not available
Wyoming	108,767	325,048

Source: US EPA 2007a, Washington State Department of Environmental Quality 2002

Wetlands are generally defined as areas inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support vegetation that is typically adapted for life in saturated soil. Wetlands include bogs, marshes, shallows, muskegs, wet meadows, estuaries, and riparian areas. According to the US Army Corps of Engineers' Wetland Delineation Manual (Cowardin et al. 1979), an area must exhibit evidence of at least one positive wetland indicator from each of the following parameters to be defined as a wetland (Environmental Laboratory 1987):

- Hydrophytic Vegetation – The land supports predominately hydrophytes. Hydrophytes are macrophytic plants with the ability to grow in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content and depleted soil oxygen levels;
- Hydric Soils – A hydric soil is a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation; and
- Hydrology – Encompasses all hydrologic characteristics of areas that are periodically inundated or have soils saturated to the surface at some time during the growing season. Such characteristics are usually present in areas that are inundated or have soils that are saturated to the surface for sufficient duration to develop hydric soils and support vegetation typically adapted for life in periodically anaerobic soil conditions.

Wetlands are often associated with perennial water sources, such as springs, perennial segments of streams, lakes, or ponds. Wetlands are considered a valuable ecological resource because of their important roles in providing fish and wildlife habitat, maintaining water quality, and flood control. Total wetland area present within any one of the project area states, on the basis of estimates from 1980, ranges from about 385,700 acres in Idaho to 175,000,000 acres in Alaska. (Table 3-18). As throughout the US, wetlands in the western states have experienced a major decline in abundance because of human disturbance; however, data show a recent net gain in wetland acreage (BLM 2006a).

Table 3-18
1980s Estimates of Project Area Wetlands

State	Wetland Area (acres)	Percent of Surface Area
Alaska	175,000,000	43.0
Arizona	600,000	0.8

Table 3-18
1980s Estimates of Project Area Wetlands

State	Wetland Area (acres)	Percent of Surface Area
California	454,000	0.4
Colorado	1,000,000	1.5
Idaho	385,700	0.7
Montana	840,300	0.9
Nevada	236,350	0.3
New Mexico	481,900	0.6
Oregon	1,393,900	2.2
Utah	558,000	1.0
Washington	938,000	2.1
Wyoming	1,250,000	2.0

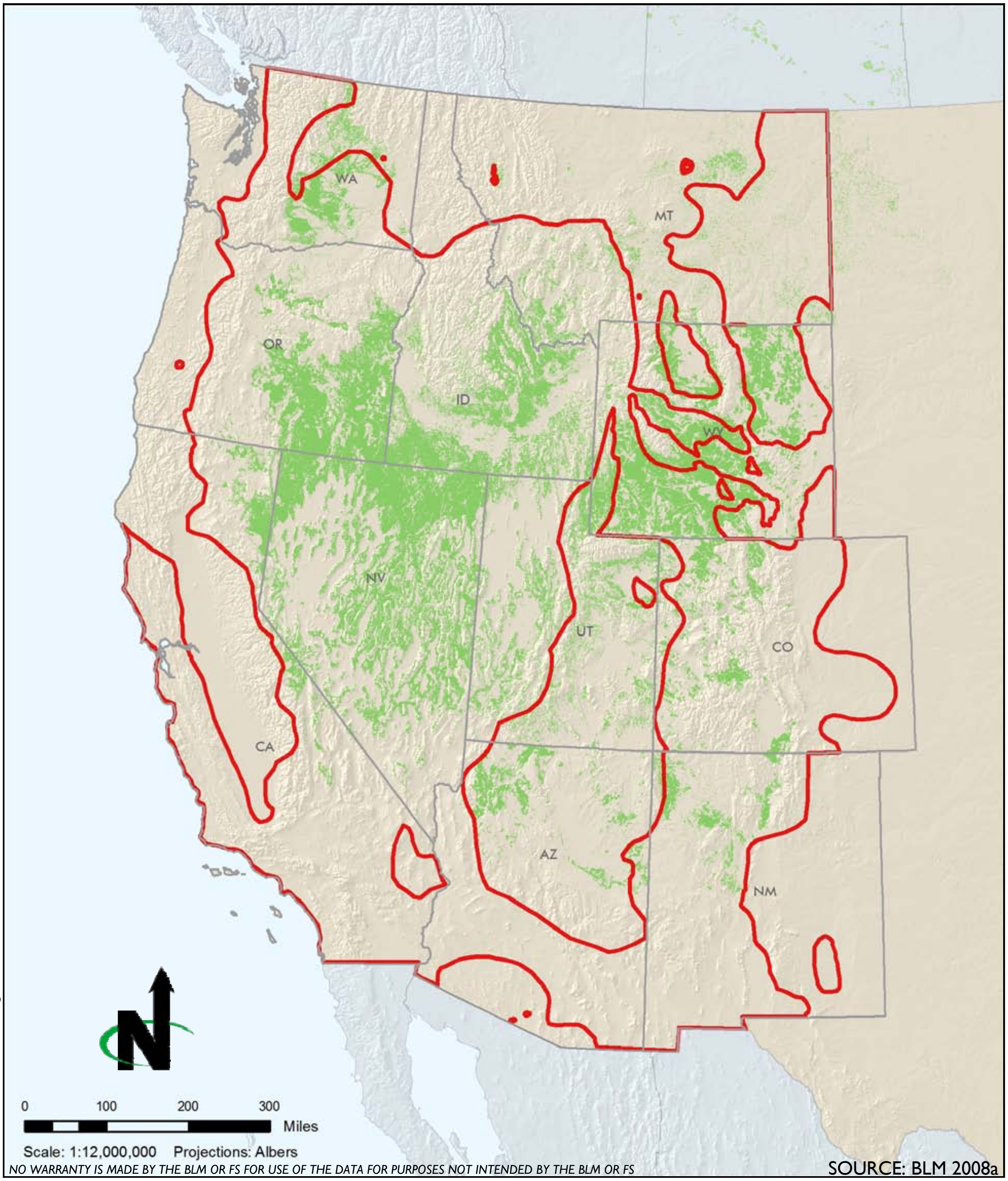
Source: US EPA 2007a, Dahl 1990

Sagebrush

Sagebrush habitats are declining rapidly across western North America. Over 350 associated plant and animal species are at risk of local or regional extirpation resulting from declining sagebrush habitat, including the sage-grouse. Broad concern over the future health of the remaining sagebrush lands has prompted the formation of cooperative partnerships among the BLM, FS, USFWS, and western state (except Alaska) wildlife agencies. (Alaska does not have sagebrush ecosystems.) Together, these partners plan and coordinate actions to conserve and manage sagebrush habitat for the benefit of sagebrush-dependent species, such as the sage-grouse.

Sagebrush ecosystems dominate approximately 118 million acres throughout western North America. Roughly 66 percent of the existing sagebrush habitats are publicly owned and managed by a federal agency. The BLM and FS are the primary agencies responsible for management of public and NFS lands containing sagebrush. The BLM has management authority for one-half of the sagebrush lands in the US. Within the project area states, the percent of sagebrush habitat managed by the BLM ranges from less than 5 percent to greater than 40 percent. The FS has stewardship of eight percent of the sagebrush habitats. Multiple use is the dominant management objective on almost all sagebrush habitats (Connelly et al 2004).

Sagebrush is distributed across every project area western state except Alaska (Figure 3-14). Sagebrush habitats cover approximately 93 million acres in the planning area. Nevada, Idaho, and Wyoming have the largest total area covered by sagebrush; all have over 20 percent of their area dominated by sagebrush.



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Sagebrush habitat is found throughout a large portion of the project area. Sagebrush is important to the greater sage-grouse for forage and for roosting cover. The greater sage-grouse cannot survive where sagebrush does not exist.

LEGEND:

Sagebrush Habitat

Potential Geothermal Area

Sagebrush Habitat in the 11 Western States

Figure 3-14

Approximately 12 percent of Washington and 17 percent of Utah is sagebrush habitat. All other states had less than 10 percent of their total area in sagebrush cover (Table 3-19).

Table 3-19
Sagebrush Cover

State	Total Acres	Project Area Sagebrush Cover (acres)	Percent of Total	Planning Area Sagebrush Cover (acres)	Percent of Total
Alaska	368,992,475	0	0	0	0
Arizona	72,776,537	3,740,960	5.1	356,363	0.5
California	100,976,703	3,210,153	3.2	3,162,519	3.1
Colorado	66,624,396	4,690,157	7.0	4,164,066	6.3
Idaho	53,338,876	13,942,093	26.1	12,468,337	23.4
Montana	94,234,060	5,753,029	6.1	3,618,861	3.8
Nevada	70,828,300	26,879,825	38.0	26,879,825	38.0
New Mexico	77,925,123	2,616,138	3.4	2,387,153	3.1
Oregon	62,125,940	14,012,905	22.6	14,009,018	22.5
Utah	54,317,654	9,173,616	16.9	4,478,491	8.2
Washington	43,064,444	4,957,259	11.5	3,388,208	7.9
Wyoming	62,593,028	23,616,814	37.7	16,579,909	26.5

Source: Meinke 2003

The sagebrush biome has changed considerably since European settlement. The current distribution, composition, and disturbance regimes of sagebrush ecosystems have been altered by disturbance, land use, and invasion of exotic plants. The areas where sagebrush habitat is most prevalent have been highly fragmented.

The number and intensity of fires has increased across much of the sagebrush biome. Cheatgrass *(Bromustectorum)* and other exotic plant species have invaded lower elevation sagebrush habitats across much of the western part of the biome, further exacerbating the role of fire in these systems. At higher elevations, juniper and pinyon woodland invasions into sagebrush habitats also have altered disturbance regimes.

Land conversion has fragmenting sagebrush habitats. Sagebrush habitats and dependent species that once were continuous now are separated by agriculture, urbanization, and development. Highly productive regions throughout the sagebrush biome that had deeper soils and higher precipitation have been converted to agriculture. Agriculture influences 49 percent of the sagebrush habitats by fragmenting the landscape or facilitating movements of potential predators and invasive species (Connelly et al. 2004).

Urbanization and increasing human populations have resulted in an extensive network of roads, power lines, railroads, and communications towers, with a resulting expanding influence on sagebrush habitats. Roads and other corridors promote the invasion of exotic plants, provide travel routes for predators, facilitate human access into sagebrush habitats, and increase the chance of human induced fires. Less than five percent of the existing sagebrush habitats are over 1.5 miles from a mapped road (Connelly et al 2004).

The BLM has adopted a National Sage-grouse Habitat Conservation Strategy to guide future actions for conserving sage-grouse and associated sagebrush habitats and to enhance the BLM's ongoing conservation efforts. Sage-grouse inhabit approximately 30 million acres on BLM lands, and another 10 million acres are considered suitable habitat. This strategy includes a partnership with the FS. It provides a framework for future conservation efforts by setting out broad goals and specific actions. The National Sage-grouse Habitat Conservation Strategy is meant to ensure that agencies successfully incorporate sage-grouse habitat conservation measures into all of their ongoing programs and activities, including geothermal leasing, land use planning, grazing, mineral leasing, and other programs (BLM 2007d). The sage-grouse is discussed in more detail below in Section 3.10, Fish and Wildlife.

Old-Growth Forests

Public and scientific interest in US' old-growth forests began in the Pacific Northwest and focused on coastal Douglas-fir and western hemlock forests that were the main habitat of the northern spotted owl. Old-growth forests are those forests that have accumulated specific characteristics related to tree size, canopy structure, snags and woody debris, and plant associations that can only occur over time. Ecological characteristics of old-growth forests emerge through the processes of succession. Old-growth forests support assemblages of plants and animals, environmental conditions, and ecological processes that are not found in younger forests (younger than 150 to 250 years) or in small patches of large, old trees. Old-growth forests often contain rich communities of plants and animals adapted because of long periods of forest stability. These varied species typically depend on the unique environmental conditions occurring exclusively in old-growth forests. Because of this, old-growth forests serve as biodiversity reservoirs for species that cannot thrive or easily regenerate in younger forest. Old-growth forests also sequester large amounts of carbon through photosynthesis, regulate hydrologic processes, and play a critical role in soil and nutrient cycling (Strittholt et al. 2006, Kaufmann et al. 2007).

Old-growth forests are often shaped over time by the natural competitive differences among species and individual trees and by small-scale disturbances affecting one or a few trees at a time. In other forests, plant succession processes are disrupted with some regularity by major biological disturbances, such as fire, insects, wind, or drought, that extend across larger areas (Marcot et al. 1997). There are many different types of old-growth forests for the diverse array of climates, soils, and topography in the western US.

Old-growth forest in the coastal Pacific Northwest and other areas where climates are wet are typical examples of forests driven largely by natural plant succession and small-scale disturbances. Such forests usually have an overstory dominated by large, old trees with multiple layers of younger, smaller trees beneath the overstory ready to replace the large, old trees when they die (Kaufmann et al. 2007).

In drier regions, forest types have evolved more in response to disturbance by fire than in response to successional processes. Old trees become a part of such forests because of adaptations that allow them to survive all but the most severe fires. In Arizona, Colorado, New Mexico, Utah, and drier parts of California, park-like forests with open canopies and grassy understories are typical. Thus, no single definition for old growth is adequate for the broad assortment of old-growth forests in the project area (Kaufmann et al. 2007).

Since the time of European settlement, approximately 72 percent of the original old-growth conifer forest has been lost, largely through logging and other developments. Of the remaining old growth, the central and southern Cascade and Klamath-Siskiyou Mountains account for nearly half. Large areas of old growth forest are also present in the Sierra Nevada, the Rocky Mountains and the Intermountain region. More than 78 percent of old-growth and 50 percent of mature forest are located on federal lands (Strittholt et al. 2006).

Since 1994, approximately 24 million acres of FS and BLM lands have been managed under the Northwest Forest Plan (FS and BLM 1994). The plan shifted federal lands management from predominantly resource extraction toward an ecosystem management approach (Thomas et al. 2006). Recent changes in NFS and public land management plans are intended to provide protection for old-growth forests throughout NFS and public lands in the west (Warbington and Beardsley 2002).

3.9.3 Climate Change

Climate change (warmer/drier summer conditions, warmer winters) may be one of the factors in recently observed changes in forest health involving large areas of tree mortality from a variety of insect agents. Many forest communities are resilient in responding to normal variations in weather and climate to which they are adapted. However, currently occurring increases in forest insect infestations and tree mortality throughout the planning area may be partially due to global climate change acting in concert with other variables such as long-term fire suppression, particularly in areas where stands are overstocked.

Due to changes in climate, grasslands and rangeland could expand into previously forested areas. Additionally, sagebrush habitats may decline sharply throughout the region and be replaced with grasslands. Increasing CO_2 concentrations also lead to preferential fertilization and growth of specific plant species, such as invaders like cheat grass. Climate change may favor certain shrub species, both native and exotic. Increased CO_2 in the atmosphere may favor growth of most woody plants and "cool season" grasses at the expense of "warm season" grasses. These and other differences among species could lead to changes in the composition of rangeland vegetation.

3.10 Fish and Wildlife

The BLM and FS have active wildlife management programs within each of their field or district offices. Wildlife management programs are largely aimed at habitat protection and improvement. The general objectives of wildlife management are to maintain, improve, or enhance wildlife species diversity, while ensuring healthy ecosystems; and to restore disturbed or altered habitat with the objective of obtaining desired native plant communities, while providing for wildlife needs and soil stability. The FS and BLM are primarily responsible for managing habitats, while state agencies (e.g., Colorado Department of Natural Resources, Utah Department of Wildlife Resources, Wyoming Game and Fish Department) have the responsibility for managing the big game, small game, and nongame fish and wildlife species in cooperation with BLM and FS. The USFWS has oversight of migratory bird species and of all federal threatened, endangered, proposed, or candidate species. The NMFS has responsibility for managing anadromous fish species such as salmon and steelhead.

The FS identifies and selects plant and animal species whose population changes are believed to reflect the effects of management activities. These species are referred to as management indicator species, and are identified in the Land and Resource Management Plans of each national forest. They are considered to represent a broader group of species or habitats that occur within each national forest and are considered sensitive to FS management activities. Impacts to these species would be considered in project-specific assessments prepared prior to project development.

The following discussions present general descriptions of the fish and wildlife species that may occur in the project area and planning area.

3.10.1 Fish and Other Aquatic Biota

Aquatic life is present throughout the rivers, streams, lakes, ponds, pools, and desert springs in the project area. The hydrologic regions described in Section 3.7, Water Resources, are used to define the regions of aquatic life found within the project area (Figure 3.-9). Essential fish species and populations are identified for each region. Species and populations presented represent the ecology of the region. They depend on the commonly occurring habitat types found in surface waters throughout each region, and the influence the aquatic and riparian community structure. Many species may occur in more that one region because of similarities in a region's ecology or as the result of human introduction.

Pacific Northwest and Alaska

The Pacific Northwest is best represented by members of the salmonid species that have a significant ecological, cultural, and commercial importance in the region. Salmonids include salmon *(Onchynchus)*, trout, char, grayling, and whitefish. All salmonids require relatively cold freshwater habitats with high water quality and diverse habitat to complete all stages of their life cycle. Thus, the conditions of surrounding forests and rangelands greatly influence salmonid survival (Quinn 2005).

Salmonids typically rely on large rivers and stream systems with direct ocean access because of their ecology. Many salmonids are anadromous, meaning the spend part of their life in freshwater (to spawn and for early development) and part of their life foraging in the ocean. Areas in Alaska within the planning area have several major river systems running through them, including the Yukon, Sustina, and Copper Rivers, as well as hundreds of smaller streams and tributaries. The most significant system in Pacific Northwest is the Columbia River Basin. With its headwaters in British Columbia, Canada, the Columbia River extends over 1,200 miles to the Pacific Ocean.

Salmonids migrate through several habitats while traveling from the ocean to breeding areas in freshwater and use all portions of the watershed, depending on the species. Chinook salmon spawn in larger faster waters, while sockeye and steelhead use headwater streams. Upon emerging from the gravel, individuals either start their migration to the sea within their first year (ocean type) or mature within rivers for two to three years before migrating to sea (stream type). In contrast, resident trout populations, such as rainbow, bull, and cutthroat, may spend their life (five to six years) in various freshwater systems, including small streams or lakes, and do not migrate to the sea (Quinn 2005).

Salmon, steelhead trout, and other native fish species support an active recreational and commercial fishery throughout the Pacific Northwest. However, sport fishing has been promoted in the Pacific Northwest, and to a lesser extent in Alaska, by introduction of various nonnative fish species. Introduced salmonids (such as brook, brown, lake, and hatchery-raised rainbow trout), centrarchids (such as bass and sunfish), and percids (such as walleye) now support much, if not most, of the nonnative sport fishing opportunities within these regions (Richter et al 1997).

A variety of aquatic invertebrates occur in northwest and Alaskan streams. These species can be quite susceptible to in-stream activity (e.g., removal of large woody debris) or disturbances in riparian zones. The diversity of aquatic insects is naturally low in glacier-fed streams. Streams flowing through conifer forest, however, support a diverse aquatic invertebrate fauna, including many mayflies, stoneflies, and caddisflies (Whittier et al. 1988). The diversity of freshwater mollusks is also usually highest in montane, spring-fed streams and pools (Forest Ecosystem Management Assessment Team 1993).

Essential Fish Habitat

Essential Fish Habitat (EFH) is defined in the Magnuson-Stevens Fishery Conservation and Management Act as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. The regulations (50 CFR 600.815[a][1][i]) specify the following requirements for EFH description:

- Fishery management plans must describe and identify EFH in text that clearly states the habitats or habitat types determined to be EFH for each life stage of the managed fish species;
- Fishery management plans should explain the physical, biological, and chemical characteristics of EFH and, if known, how these characteristics influence the use of EFH by the species/life stage;
- Fishery management plans must identify the specific geographic location or extent of habitats described as EFH; and
- Fishery management plans must include maps of the geographic locations of EFH or the geographic boundaries within which EFH for each species and life stage is found.

The mandate for federal agencies to evaluate potential effects on EFH applies to all species managed under a federal fishery management plan. Two fishery management plans for commercial and recreational salmon fisheries exist in the planning area (US Department of Commerce, National Oceanic and Atmospheric Administration 2007). These fishery management plans include Alaska, Washington, Oregon, California, and Idaho. The NMFS and Pacific Fisheries Management Council prepared an EIS to evaluate EFH for areas in Alaska. Appendix D of that EIS provides a description of all EFH for federally managed salmonid species in the Alaska region. Amendment 14 of the Pacific Coast Salmon Plan (Pacific Fishery Management Council 2000) contains a complete identification and description of EFH for the states of Washington, Oregon, California, and Idaho, along with an assessment of actions that could result in adverse impacts and actions to encourage conservation and enhancement of EFH.

The Pacific coast salmon fishery EFH includes those waters and substrate necessary for salmon production needed to support a long-term sustainable salmon fishery and salmon contributions to a healthy ecosystem. In estuarine and marine areas, salmon EFH extends from the near-shore and tidal submerged environments within state territorial waters out to the full extent of the exclusive economic zone (200 nautical miles). The EFH extends from Cape Prince of Wales in Alaska, on the western tip of the Seward peninsula, south to Point Conception in central California. The EFH for anadromous salmon also includes freshwater habitats such as streams, lakes, ponds, wetlands, and most historic habitat accessible to salmon (except above certain impassable natural barriers) in Alaska, Washington, Oregon, Idaho, and California.

Salmon typically use large stream and river systems with direct ocean access. However, they also are found in smaller coastal streams. Alaska has the greatest number of salmon-bearing streams and rivers with the large majority of them occurring in the southeast and throughout the southern gulf area. The most significant river system in Pacific Northwest (Washington, Oregon, and Idaho) is the Columbia River Basin. With its headwaters in British Columbia, the Columbia River extends over 1,200 miles to the Pacific Ocean. The Snake River is part of this system. The Sacramento River system is the largest system in California supporting salmon species. The Russian, Eel, and Klamath River systems are also important for salmon in California.

Salmon productivity is dependent on both ocean and freshwater conditions. Suitable habitat in freshwater generally is dictated by flow regime, water quality, habitat structure, and biotic interactions. All salmon require suitable habitat for spawning, incubation, and rearing. Generally, adult salmon require spawning gravel (less than two inches in diameter) and overhead stream bank or vegetative cover from predation and ultraviolet radiation, while eggs and newly hatched salmon (alevins) require stable gravel and cool (less than 57 degree F) water that is well oxygenated (Quinn 2005).

Lower Colorado River, Great Basin, and the Rio Grande

These regions cover most of Nevada, Arizona, New Mexico, and western Utah, as well as areas in eastern California. Grasses and shrubs cover large expanses and are critical for reducing runoff and erosion. Precipitation in these arid regions is extremely seasonal and arrives in intense pulses. Thus, the natural hydrology of the rivers and streams is highly variable and episodic. Native fish populations thrive on these pulsed intermittent flows and the natural flow regimes are considered optimum for sustaining native fish populations (Poff et al. 1997). However, many of the waterways in the southwest have been altered dramatically for water storage, flood abatement, and irrigation purposes.

Fish species distribution is limited because of a lack of habitat continuity. Streams often terminate in closed lakes, desiccate during dry periods, or go subterranean. Springs occur throughout the desert ecosystem, ranging from quiet pools or trickles to active aquifers. Many larger springs emit warm water, with temperatures above the mean annual air temperature, and range from fresh to highly mineralized, carrying large amounts of dissolved materials or extremely low dissolved oxygen levels (Naiman 1981). These pools often harbor endemic species that are found nowhere else.

Nonnative species have been introduced into many areas, and their presence can reduce numbers of native species through competition, hybridization, predation, and spread of pathogens to which they have developed resistance in their home waters, but to which native species have none (Marsh and Douglas 1997).

Many of the rivers in these regions have changed dramatically over the last hundred years. The Colorado River, which was once a warm, silted, swift river, is now a cold, clear series of artificial impoundments such as the Glen Canyon Dam that forms Lake Powell. The impoundments have altered aquatic habitats and species composition within most waterways in these regions. As a result, most native fish populations in many of the waterways have declined substantially. Overall, nonnative fish species in these hydrologic regions now outnumber native species in terms of numbers of species, population densities, and often biomass at many localities (Marsh and Douglas 1997).

The Colorado River is the primary river of the southwestern US, draining approximately 242,000 square miles from portions of Wyoming, Colorado, Utah, New Mexico, Arizona, Nevada, and California. The headwaters of the Colorado River are located in Rocky Mountain National Park in Colorado, from which the river flows southwest toward the Gulf of California. The Colorado River Basin is divided into two basins, the lower and upper, with a dividing line near Lee's Ferry, Arizona. The native fish community within the Lower Colorado River hydrologic region is dominated by fishes within the minnow and sucker families. Minnow species include the threatened Colorado pikeminnow and bonytail chub. The threatened razorback sucker is also found here.

Impoundments have had the greatest impacts on these fish communities (Minckley and Deacon 1991).

Bonytail chub was historically common, migrating throughout the main stem of the Colorado River and many of its tributaries, including the Green, Gunnison, Yampa, and Gila Rivers, before the construction of large dams (Kaeding et al. 1986). Although bonytail chub continues to be found in low numbers from several human-made lakes, including Lake Mohave, the temperature and physical and chemical composition of these lakes is very different from those in which the fish evolved (Minckley and Deacon 1991).

The headwaters of the Rio Grande originate in the Rocky Mountains of southwestern Colorado, and the river meanders approximately 1,900 miles across Colorado, New Mexico, and Texas before terminating at the Gulf of Mexico. NFS and public lands within the Rio Grande region are limited to the upper and middle reaches of this drainage. Historically, riparian woodlands in the Rio Grande valley were a mosaic of various-aged stands dominated by cottonwood and willow (Cassell 1998). However, conversion of much of this land to residential and agricultural uses has modified the floodplain, thereby significantly reducing the quantity and quality of aquatic habitat (Cassell 1998). These changes, combined with in-stream modifications, have reduced fish habitat considerably throughout the region.

Prior to the construction of dams like the Cochiti Dam, the Rio Grande had characteristics similar to the Colorado River and was considered a swift, warm, muddy river (Scurlock 1998). The settling effects of dam reservoirs have resulted in slower, clearer, colder water. This modification of water quality has had a debilitating effect on native fish species, such as the Rio Grande silvery minnow that was once wide spread.

Many nonnative fish species have adapted well to the in-stream modifications to both the Lower Colorado River and Rio Grande (Marsh and Douglas 1997). Usually more aggressive than native fish and able to outcompete them for resources, these nonnative species include walleye, bass (large and smallmouth), and rainbow, brook, and brown trout (Marsh and Douglas 1997).

The Great Basin covers an arid expanse of approximately 190,000 square miles and is bordered by the Sierra Nevada Range on the west, the Rocky Mountains on the east, the Columbia Plateau on the north, and the Mojave and Sonoran Deserts on the south. The Great Basin is the area of internal drainage between the Rocky Mountains and the Sierra Nevada Range. Streams in this area never reach the ocean, but are instead confined, draining to the base of the basin, and typically resulting in terminal lakes (such as Mono Lake and the Great Salt Lake), marshes, or sinks that are warm and saline (Moyle 1998).

Many Great Basin fish are adapted to extreme conditions. Trout are predominantly found in lakes and streams at higher elevations (Behnke 1992). Bonneville cutthroat trout have persisted in the isolated, cool mountain streams of the eastern Great Basin, while Lahontan cutthroat trout populations occupy small, isolated habitats throughout the basin. These trout species are unusually tolerant of high and fluctuating temperatures, high pH, and increased levels of dissolved solids.

Water diversions, subsistence harvest, and stocking with nonnative fish (particularly rainbow trout) have caused the extirpation of the Bonneville cutthroat trout from most of its range. Although Lahontan cutthroat trout were once common in desert lakes (including Pyramid, Walker, Summit, and Independence Lakes) and large rivers (such as the Humboldt, Truckee, and Walker Rivers), they have declined in numbers overall, disappearing in many areas (Hudson et al. 2000). The decline of Lahontan cutthroat trout abundance is a result of habitat loss, interbreeding with introduced rainbow trout, and competition with other species of trout. These factors continue to be the primary threats to this species (Coffin and Cowan 1995).

Minnows and pupfish are the dominant fish species at lower elevations and are found in thermal artesian springs and streams (Hubbs 1982). Various native and nonnative minnows, (e.g., dace, chubs, shiners) are common throughout streams and lakes of the basin. Pupfish, however, are very site specific and live, by choice, at the extreme upper limit of their zone of thermal tolerance (Naiman 1981). The most significant problem facing these fish are the limited water supply. Desert fishes have a tenuous hold on survival under natural conditions, occurring only in the few permanent springs, rivers, and lakes, and their existence has been placed in doubt by human activities (Hubbs 1982). Pumping groundwater for agriculture has threatened several pupfish populations, including the Devil's Hole pupfish (Naiman 1981).

The Upper Colorado River Basin

Three distinct aquatic zones have been identified in the Upper Colorado Basin (Joseph et al. 1977). The upper (headwater) zone is characterized by cold and clear water, a high gradient, and a rocky or gravel substrate. Resident salmonid populations are predominant in this zone. An intermediate zone occurs as the stream flows out of the upper zone. Within the intermediate zone, water discharge rates and temperature increase, and water is turbid during spring runoff and after heavy rainfall. The substrate is generally rocky with occasional expanses of sand. The lower (large-river) zone has warm water, meandering sections, and a low gradient in flat terrain. Minnows and suckers are the dominant fish communities of the intermediate and lower zones.

The construction of reservoirs, such as Fontenelle and Flaming Gorge, has had profound effects on water flow and quality throughout the upper basin region; lower summer water temperatures have resulted, and spawning of native fish has virtually ceased (Wullschleger 2000). The humpback chub, for example, prefers deep, fast-moving, turbid waters often associated with canyon bound segments of the rivers (Douglas and Marsh). Historically, this species occurred in great numbers throughout the Colorado River system from the Green River in Wyoming to the Gulf of California in Mexico. Today, due to lower water temperature and migration routes blocked by dams, this species can only be found in limited deep, canyon-bound portions of the Colorado River (Douglas and Marsh 1996).

Native salmonids in the upper zone of the Upper Colorado River Basin, including the Gila and Apache trout, are disappearing with the introduction of rainbow, brook, and cutthroat trout for sport fishing (Behnke 1992). The habitat immediately downstream of constructed reservoirs favors these nonnative salmonids (Platania 2003). Nonnative species are highly competitive for available resources and interbreed with native species causing hybridization. Both actions adversely affect native species (USFWS 1994, Minckley and Deacon 1991). Populations of native species within lakes are also declining as a result of competition with, and predation by, introduced nonnative species, such as carp, northern pike, and red shiner (Rinne 2003).

California

California has two distinct fish habitat regions: northern and southern California. The northern region extends from the Oregon border south to Sacramento (the most southern reaches of salmon distribution in North America). This region includes rain-fed coastal streams, snow-fed streams of western Sierra Nevada and the Central and San Joaquin Valleys. Habitat characteristics are very similar to those observed in the western Pacific Northwest, with a dominance of evergreen forests throughout the area. Streams in the coastal region usually have steep drainages and are characterized by extreme seasonal flow, flooding in the winter and becoming intermittent in summer (Moyle 1976). Water flow in snow-fed streams is more constant than in coastal streams, a condition to which native fish are adapted.

Freshwater fish habitats within southern California are located predominantly within the arid southeast region of the state and include numerous rivers and lakes. Native fish communities, such as pupfish and minnows in the lower elevations and cutthroat trout in the mountainous regions, and their aquatic habitats exhibit characteristics similar to those seen in the Lower Colorado and Great Basin regions.

Missouri River Basin

The Missouri River historically carried a heavy silt load collected from tributaries in the northern part of its drainage. Its wide and diverging channel created shifting sandy islands, spits, and pools, resulting in fish species suited to its turbid and dynamic conditions. Many of the fish communities within the upper reaches of the Missouri River are considered benthic fishes and include sturgeon and minnows (Scarnecchia et al. 2002).

NFS and public lands in Montana occur predominantly in the northeastern portion of the state in the Milk River Basin subsection of the Missouri River Basin. This area has relatively high densities of depressional wetlands, often called prairie potholes, as they are dominated by shortgrass prairies. The upper reaches of the Missouri River and its major tributaries maintain the healthiest fish populations in the basin (Scarnecchia et al. 2002). However, dams built along the main stem of the Missouri River in Montana, such as the Fort Peck Dam, have altered flows and sediment transport and impede fish migration patterns. These changes have contributed to the decline of many native main stem species, including, sturgeon, and several species of chub (family Cyprinidae).

Introduced species, such as rainbow trout, have been stocked throughout Montana. Rainbow trout have adapted well to the wide range of habitats available within the basin. The species has successfully integrated into this aquatic system and has caused a severe reduction in the range of native cutthroat trout through hybridization and competition. Other introduced species that have adapted well to the modifications of the Missouri River drainage in Montana include smallmouth bass, walleye, and white crappi.

Portions of Wyoming east of the Continental Divide are drained by the Missouri River Basin, while southwest portions of the state drain into the Upper Colorado River Basin. Native and introduced salmonids such as rainbow, brook, and cutthroat trout dominate fish communities within these areas. Streams flowing through the arid desert plains of Wyoming are characterized by low gradients and meandering or braided channels with sand and gravel substrates. Riparian vegetation in this area is dominated by cottonwoods, willows, shrubs, and grasses. Central and northern Wyoming are considered high cold desert. Native and nonnative minnows and suckers dominate fish communities in these areas.

Arkansas-White-Red Region

This hydrologic region occupies the drainage of the Arkansas, Canadian, and Red River basins above the points of the highest backwater effect of the Mississippi River. It includes all of Oklahoma and parts of Colorado, New Mexico, Texas, Kansas, Missouri, and Louisiana. Only a relatively small proportion of NFS and public lands are found in this region, primarily concentrated near the headwaters of the Arkansas River in central Colorado and near the headwaters of the Canadian River in northeastern New Mexico. Surface waters generally originate from precipitation falling in the eastern Rocky Mountains. Precipitation is relatively sparse in the summer and fall months, and surface water flow is typically dependent on snowmelt in the mountainous areas. Surface water resources are used extensively for agricultural irrigation.

Fish species in the upper headwaters of these rivers are similar to those in the Upper Colorado, supporting trout and other cold-water species (Behnke 1992). At lower elevations, the species assemblage is comprised primarily of warm-water species, both introduced and native, such as and several species of chub (family Cyprinidae), perches and darters (family Percidae), largemouth bass, black crappie, catfish, and common carp (Lohr and Fausch 1997).

Amphibians and Reptiles

Public and NFS lands in the planning area support a wide variety of amphibians and reptiles. The number of amphibian species reported in these states ranges from as few as 8 species reported in Alaska to 68 species reported in California. The number of reptile species reported from these states ranges from four species (zero terrestrial) in Alaska to 112 species in Arizona (Table 3-20). The amphibians reported from these states include frogs, toads, and salamanders that occupy a variety of habitats that include forested headwater streams in mountain regions, marshes, and wetlands, and xeric habitats in the desert areas of the Southwest. The reptile species include a wide variety of turtles, snakes, and lizards. Amphibian and reptile species that are threatened or endangered are listed in Appendix H.

Table 3-20
Number of Wildlife Species in the Project Area[1]

State	Amphibian	Reptiles	Mammals[2]	Birds
Alaska	8	4[3]	83	445
Arizona	29	112	169	533
California	68	90	182	626
Colorado	18	56	131	478
Idaho	15	24	111	402
Montana	18	17	110	417
Nevada	15	54	125	472
New Mexico	25	96	156	510
Oregon	31	29	137	492
Utah	17	57	136	428
Washington	27	22	116	468
Wyoming	12	27	121	420

[1] Excludes marine species, native species that have been extirpated, and feral domestic species

[2] Includes wild horse and burros

[3] The four (4) reptile species found in Alaska are sea turtles with limited or no terrestrial presence.

Source: Adapted from DOE and DOI 2007 (Table 3.8-2) with additional data provided from Sage 1986, FS 1995a, Igl 1996

Birds

Birds are the most prolific animal family found in the project area (Table 3-20). The number of bird species ranges from 402 in Idaho to 626 in California (Igl

1996). The coastal states (Alaska, California, Oregon, and Washington) include oceanic species such as puffin, frigatebird, and albatross that would not occur in the planning area. Bird species that are threatened or endangered are listed in Appendix H.

Birds of Conservation Concern 2002 is the most recent USFWS effort to accurately identify the migratory and nonmigratory bird species (beyond those already designated as federally threatened or endangered) that represent the highest conservation priorities and draw attention to species in need of conservation action. Birds of Conservation Concern 2002 includes 276 species that are primarily derived from assessment scores from three major bird conservation plans: Partners in Flight, the US Shorebird Conservation Plan, and the North American Waterbird Conservation Plan. Bird species considered for inclusion on lists in this report include nongame birds, game birds without hunting seasons, subsistence-hunted nongame birds in Alaska, and ESA candidate, proposed endangered or threatened, and recently delisted species.

Within the project area, a number of important bird areas have been identified by the National Audubon Society. Important bird areas are locations that provide essential habitats for breeding, wintering, or migrating birds. While these sites can vary in size, they are discrete areas that stand out from the surrounding landscapes. Important bird areas must support one or more of the following:

Species of conservation concern (e.g., threatened or endangered species);

- Species with restricted ranges;
- Species that are vulnerable because their populations are concentrated into one general habitat type or ecosystem; or
- Species or groups of similar species (e.g., waterfowl or shorebirds) that are vulnerable because they congregate in high densities.

The important bird areas program has become a key component of many bird conservation efforts and efforts to identify and recognize important bird areas are ongoing throughout the project area. The current number of important bird areas ranges from 9 in Wyoming to 147 in California. Identification of important bird areas is continuing, and these numbers are expected in increase (National Audubon Society 2007).

Migratory Birds

Many of the bird species in the project area are seasonal residents within individual states and exhibit seasonal migrations. These birds include waterfowl, shorebirds, raptors, and neotropical songbirds. The USFWS has the legal mandate and the trust responsibility to maintain healthy migratory bird populations (USFWS 2004c). The regulatory framework organized to protect the migratory birds includes:

- *Migratory Bird Treaty Act.* The Migratory Bird Treaty Act implements a variety of treaties and conventions between the US, Canada, Mexico, Japan, and Russia. This treaty makes it unlawful to take, kill, or possess migratory birds, as well as their eggs or nests. Most of the bird species reported from the project area are classified as migratory under this Act.
- *Executive Order 13186: Responsibilities of Federal Agencies to Protect Migratory Birds*. Under this Executive Order, each federal agency taking an action that could have, or is likely to have, negative impacts on migratory bird populations must work with the USFWS to develop a memorandum of understanding to conserve those birds. The memorandums of understanding developed by this consultation are intended to guide future agency regulatory actions and policy decisions.

The USFWS has outlined a plan to conserve and protect migratory birds in its Migratory Bird Strategic Plan 2004-2014. The strategy includes direct collaboration with both the FS and BLM in making land use and planning decisions. The protection of migratory bird species of conservation concern is the primary goal of the plan.

The planning area falls within two of the four major North American migration flyways (Lincoln et al. 1998): the Central Flyway and the Pacific Flyway. These pathways are used in spring by birds migrating north from wintering areas to breeding areas, and in fall by birds migrating southward to wintering areas.

The Central Flyway includes the Great Plains–Rocky Mountain routes. These routes extend from the northwest Arctic coast southward between the Mississippi River and the eastern base of the Rocky Mountains and encompass all or most of the states of Wyoming, Colorado, and New Mexico, and portions of Montana, Idaho, and Utah. In western Montana, this flyway crosses the Continental Divide and passes through Utah's Great Salt Lake Valley before turning eastward. The majority of birds make using the central flyway make relatively direct north and south migrations between northern breeding grounds and southern wintering areas (Birdnature.com 2007, Lincoln et al. 1998).

The Pacific Flyway includes the Pacific Coast Route, which occurs between the eastern base of the Rocky Mountains and the Pacific coast of the US. This flyway encompasses Alaska, California, Nevada, Oregon, and Washington, and portions of Montana, Idaho, Utah, Wyoming, and Arizona. Birds migrating from the Alaskan Peninsula follow the coastline to near the mouth of the Columbia River, then travel inland to the Willamette River Valley before continuing southward through interior California (Lincoln et al. 1998). Birds migrating south from Canada pass through portions of Montana and Idaho and then migrate either eastward to enter the Central Flyway, or turn southwest along the Snake and Columbia River Valleys and then continue south across central Oregon and the interior valleys of California (Birdnature.com 2007). This route is not as heavily used as some of the other migratory routes in North America (Lincoln et al. 1998).

Waterfowl, Wading Birds, and Shorebirds

Waterfowl (ducks, geese, and swans), wading birds (herons and cranes), and shorebirds (plovers, sandpipers, and similar birds) are among the more abundant bird groups in the project area. Many of these species exhibit extensive migrations from breeding areas in Alaska and Canada to wintering grounds in Mexico and southward (Lincoln et al. 1998). Most are ground-level nesters, and many sometimes forage in relatively large flocks on the ground or water. Within the region, migration routes for these birds are often associated with riparian corridors and wetland or lake stopover areas (Lincoln et al. 1998).

Waterfowl species are popular game species and are hunted throughout the project area. Ducks, geese, teal, and cranes are all commonly hunted and are managed primarily by state fish and wildlife agencies in conjunction with USFWS. Various conservation and management plans exist for waterfowl, shorebirds, and water birds.

Neotropical Migrants

Songbirds of the order *Passeriformes* represent the most diverse category of birds, with the warblers and sparrows representing the two most diverse groups of passerines. Passerines exhibit a wide range of seasonal movements, with some species remaining as year-round residents and others undergoing migrations of hundreds of miles or more (Lincoln et al. 1998). As the largest and most diverse category of birds, breeding, nesting, and feeding habits vary greatly (Lincoln et al. 1998).

Birds of Prey

The birds of prey include the raptors (hawks, falcons, eagles, kites, and osprey), owls, and vultures. The largest of these birds are the premier avian predators in their respective ecosystems. Raptors and owls species vary considerably with regard to their seasonal migrations. Some species are virtually nonmigratory, and others migrate only in the northern portion of their range while remaining nonmigratory their southern range. Finally, other species migrate throughout their ranges.

The bald eagle and golden eagle are protected under the Bald and Golden Eagle Protection Act (16 USC 668– 668d, 54 Stat. 250, as amended), which prohibits the taking or possession of, or commerce in, bald and golden eagles, with limited exceptions for permitted scientific research and Native American religious purposes. The 1978 amendment authorizes the Secretary of the Interior to permit the taking of golden eagle nests that interfere with resource development or recovery operations. The BLM and FS field or district offices also have specific management guidelines for raptors, including golden eagles.

Raptors forage on a variety of prey, including small mammals, reptiles, other birds, fish, invertebrates, and, at times, carrion. Hunting and foraging varies significantly among species, with some being very active hunters, pursuing prey on the wing, and others foraging from a perch, All forage during the day. Owls forage in a similar manner, although most hunting occurs at night, though some owl species may be active during the day (Sovern et al 1994).

The vultures are represented by three species: the turkey vulture, which occurs in each of the western states; the black vulture, which is reported from Arizona, California, and New Mexico; and the endangered California condor, reported from Arizona and California. These birds are large soaring scavengers that feed on carrion.

Upland Game Birds

Upland game birds that are native to the project area include several native species of grouse, including the greater sage-grouse and Gunnison sage-grouse, and mourning doves. Ring-necked pheasant, chukar, gray partridge, and wild turkey are all nonnative species that have been introduced but are managed as game species. All of the upland game bird species within the project area are year-round residents. Ring-necked pheasants and greater sage-grouse have experienced long-term declines due to the degradation and loss of important sagebrush-steppe and grassland habitats (BLM 2005b).

Most concerns about upland game birds in the project area have focused on the greater sage-grouse. Greater sage-grouse require contiguous, undisturbed areas of high-quality habitat during their four distinct seasonal periods of breeding, summer-late brooding and rearing, fall, and winter (Connelly et al. 2004). Figure 3.10-1 shows the current and historical distribution of sage grouse in the project area.

Sagebrush is important to the greater sage-grouse for forage and for roosting cover, and the greater sage-grouse cannot survive where sagebrush does not exist (Connelly et al 2004). Sagebrush is found throughout and almost exclusively in the temperate desert ecoregion division, although the eastern portions of the sagebrush biome do extend into the temperate steppe ecoregion division. The distance between leks (strutting grounds) and nesting sites can exceed 12 miles (Connelly et al. 2000, Bird and Schenk 2005). The annual movements of migratory populations can exceed 60 miles, and migratory populations can have home ranges that exceed 580 square miles (Bird and Schenk 2005). However, the greater sage-grouse has a high fidelity to a seasonal range. They also return to the same nesting areas annually (Connelly et al. 2000, 2004). Leks are generally areas supported by low, sparse vegetation or open areas surrounded by sagebrush that provide escape, feeding, and cover. They can range in size from small areas of 0.1 to 10 acres to areas of 100 acres or more (Connelly et al. 2000). Nesting generally occurs 1 to 4 miles from lek sites, although it may range up to 12 miles (Connelly et al 2004). Suitable winter habitat requires sagebrush 10 to 14 inches above snow level with a canopy cover ranging from 10 to 30 percent. Wintering areas are potentially the most limiting seasonal habitat for greater sage-grouse (Connelly et al 2004).

While no single or combination of factors have been proven to have caused the decline in greater sage-grouse numbers over the past half-century, the decline in greater sage-grouse populations is thought to be due to a number of factors including drought, oil and gas wells and their associated infrastructure, power lines, predators, and a decline in the quality and quantity of sagebrush habitat (due to livestock grazing, range management treatments, and development activities) (Connelly et al. 2004, Crawford et al. 2004). West Nile virus is also a significant stressor of greater sage-grouse (Naugle et al. 2004). The BLM manages more habitats for greater sage-grouse than any other entity. It has developed a National Sage-Grouse Habitat Conservation Strategy to manage public lands in chorus with the FS and other agencies in a manner that will maintain, enhance, and restore greater sage-grouse habitat while providing for multiple use (Connelly et al 2004). The strategy is consistent with the individual state sage-grouse conservation planning efforts. The purpose of this strategy is to set goals and objectives, assemble guidance and resource materials, and provide more uniform management directions to the multiple federal and state sage grouse conservation effort being led by state wildlife agencies (BLM 2004b). More on sage grouse and sagebrush compatibility with geothermal development can be found in text box 4.10-1.

Big Game

The following presents a generalized overview of the big games species. Table 3-21 presents the conservation status (i.e., whether a species is thriving or is rare or declining) for the big games species within the project area.

Elk (Cervus canadensis). Elk are generally migratory between their summer and winter ranges, although some herds do not migrate (i.e., occur within the same area year-round) (BLM 2004a). Their summer range occurs at higher elevations. Aspen and conifer woodlands provide security and thermal cover, while upland meadows, sagebrush/mixed grass, and mountain shrub habitats are used for forage. Their winter range occurs at mid to lower elevations where they forage in sagebrush/mixed grass, big sagebrush and rabbitbrush, and mountain shrub habitats (BLM 2004b). They are highly mobile within both summer and winter ranges in order to find the best forage conditions. In winter, they congregate into large herds of 50 to more than 200 individuals (BLM 2004a). The crucial winter range is considered to be the part of the local elk

Table 3-21
State Conservation Status Ranks for the Big Game Species in the Project Area

	State Conservation Status Rank											
Species	**AK**	**AZ**	**CA**	**CO**	**ID**	**MT**	**NM**	**NV**	**OR**	**UT**	**WA**	**WY**
Elk (*Cervus canadensis*)	-	NR	AS	S	S	S	V	S	S	AS	S	S
Mule deer (*Odocoileus hemionus*)	NR	S	S	S	S	S	S	S	AS	S	S	S
White-tailed deer (*Odocoileus virginianus*)	-	S	-	S	S	S	AS	-	NR	CI	S	S
Proghorn antelope (*Antilocapra americana*)	-	S	AS	AS	S	S	S	S	AS	AS	PE	S
Bighorn sheep (*Ovis canadensis*)	-	AS	V	AS	V	AS	CI	V	I	V	V	V
Moose (*Alces americanus*)	NR	-	-	E	S	S	-	-	-	V	I	S
American bison *(Bos bison)*	-	E	U	PE	CI	I	NR	PE	PE	I	PE	CI
Caribou (*Rangifer tarandus*)	NR	-	-	-	NR	NR	-	-	-	-	CI	-
Black bear (*Ursus americanus*)	NR	S	S	S	S	S	AS	AS	AS	V	S	S
Grizzly bear (*Ursus arctos*)	NR	PE	PE	PE	CI	I	PE	PE	PE	PE	CI	CI
Cougar (*Puma concolor*)	-	AS	S	AS	S	AS	V	S	AS	AS	AS	AS

– = the state is not within the species' range
U (unranked) – conservation status not yet assessed
AS (apparently secure) – uncommon but not rare, some cause for long-term concern due to declines or other factors
S (secure) – common, widespread, and abundant
V (vulnerable) – vulnerable due to a restricted range, relatively few populations (often 80 or fewer), recent or widespread declines, or other
CI (critically imperiled) – critically imperiled because of extreme rarity (often 5 or fewer occurrences) or because some factors such as very steep declines make it especially vulnerable to extirpation
PE (presumed extirpated) – assumed that a wild population no longer occurs

I (imperiled) – imperiled because of rarity due to a very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it vulnerable to extirpation
E (exotic) – nonnative, present due to direct or indirect human interaction
NR (not ranked)- Nation or state/province conservation status not yet assessed.
Source: NatureServe 2007

range where about 90 percent of the local population is located during an average of five winters out of ten from the first heavy snowfall to spring green-up (BLM 2005b). Elk calving generally occurs in aspen-sagebrush parkland vegetation and habitat zones during late spring and early summer (BLM 2004a). Calving areas are mostly located where cover, forage, and water are in close proximity (BLM 2005b). They may migrate up to 60 miles annually (NatureServe 2007). Elk are susceptible to chronic wasting disease (BLM 2004a).

Mule Deer (Odocoileus hemionus). Mule deer occur within most ecosystems within the region, but attain their highest densities in shrub lands characterized by rough, broken terrain with abundant browse and cover (BLM 2005). Home range size can vary from 74 to 593 acres or more, depending on the availability of food, water, and cover (NatureServe 2007). Some populations of mule deer are resident (particularly those that inhabit plains), but those in mountainous areas are generally migratory between their summer and winter ranges (BLM 2004b; NatureServe 2007). In arid regions, they may migrate in response to rainfall patterns (NatureServe 2007). In mountainous regions, they may migrate more than 62 miles between high summer and lower winter ranges (NatureServe 2007). In western Wyoming, mule deer migrate 12 to 98 miles (Sawyer and Whirter 2005). Their summer range occurs at higher elevations that contain aspen and conifers and mountain browse vegetation. Fawning occurs during the spring while they are migrating to their summer range. This normally occurs in aspen-mountain browse intermixed vegetation (BLM 2004a).

Mule deer have a high fidelity to specific winter ranges where they congregate within a small area at a high density. Their winter range occurs at lower elevations within sagebrush and pinyon-juniper vegetation. Winter forage is primarily sagebrush, with true mountain mahogany, fourwing saltbush, and antelope bitterbrush also being important. Pinyon-juniper provides emergency forage during severe winters (BLM 2004a). Overall, mule deer habitat is characterized by areas of thick brush or trees (used for cover) interspersed with small openings (for forage and feeding areas); they do best in habitats that are in the early stage of succession (Utah Division of Wildlife Resources 2007). Prolonged drought and other factors can limit mule deer populations. Several years of drought can limit forage production, which can substantially reduce animal condition and fawn production and survival. Severe drought conditions were responsible for declines in the population size of mule deer in the 1980s and early 1990s (BLM 2004a). In arid regions, they are seldom found more than 1.0 to 1.5 miles from water (BLM 2004a). Mule deer are also susceptible to chronic wasting disease. When present, up to three percent of a herd's population can be affected by this disease. Some deer herds in Colorado and Wyoming have experienced significant outbreaks of chronic wasting disease (BLM 2004a).

Wintering Areas

Ungulates (such as deer, elk, and caribou) become energetically challenged during the late fall and winter season, especially at higher elevations and latitudes. This is the result of lower-quality and less-accessible food resources combined with harsher environmental conditions, such as cold temperatures, high winds, minimal water, and deep or crusted snow. A reprieve comes in spring when new plant growth becomes available (Eastland et al. 1989, Patterson and Messier 2001).

Survival during the winter season is accomplished by minimizing energy expenditures and utilizing stored body fat reserves as a supplemental energy source. Behavioral adaptations are critical for winter survival. Ungulates will migrate to wintering areas where relatively high-quality and abundant winter food resources are in close proximity to protection from harsh weather and cover from predators. Ungulates also reduce their movement and minimize body heat loss and energy expenditure as much as possible. Finally, they typically congregate in larger winter groups that facilitate trail development in deep snow conditions and improve predator detection and defense (Christianson and Creel 2007).

Winter range is often found in river valleys and riparian areas. These areas possess topographic variation and vegetative productivity that provides adequate cover and good winter browse conditions. South-facing valley slopes have relatively lower snow accumulations and warmer resting sites. Valleys provide protection from high wind chills (Christianson and Creel 2007). However, myriad factors (such as temperature, precipitation, and winter severity) can change from year to year. This can have a direct effect on flora and fauna in and around wintering areas. Thus, winter ranges are subject to boundary changes from year to year, as well as relative use by wintering ungulates (Christianson and Creel 2007).

Key ungulate winter ranges play a disproportionately large role, given their localized size and distribution, in maintaining the overall productivity of regional ungulate populations. These ranges ensure that a significant proportion of the breeding population survives to the next year (Christianson and Creel 2007).

Development, recreation, and resource-extraction activity within and adjacent to key wintering areas adds stress and increases energy drain for animals. They may be forced to move about more than normal and even relocate to less favorable habitat. This becomes an increasingly significant factor as winter progresses. Industrial activity may also create temporary and permanent access that exposes animals to additional non-industrial disturbances and to greater pressure from predators (FS 2001).

Because of the importance of winter ranges, USFWS, FS, BLM, and state fish and game departments manage these areas carefully to ensure proper game management and healthy ecosystems on lands they manage. Traditional high-use and high-quality winter ranges have been identified and mapped by various agencies. Mapping is based of several decades of winter aerial population surveys, supplemented by habitat assessments using air photo interpretation and ground surveys (FS 2001, USFWS 2007a).

White-tailed Deer (Odocoileus virginianus). White-tailed deer inhabit a variety of habitats, but are often associated with woodlands and agricultural lands (Colorado Division of Wildlife 2007). Within arid areas, they are mostly associated with riparian zones and montane woodlands that have more mesic conditions. They can also occur within suburban areas.

Urban areas and very rugged mountain terrain are unsuitable habitats (NatureServe 2007). White-tailed deer occur in two social groups: adult females and young; and adult and occasionally yearling males. However, adult males are generally solitary during the breeding season except when with females (NatureServe 2007). The annual home range of sedentary populations can average as high as 1,285 acres, while some populations can undergo annual migrations of up to 31 miles. In some areas, the density of white-tailed deer may exceed 129 per square mile (NatureServe 2007).

Snow accumulation can have a major controlling effect on populations (NatureServe 2007). They mostly feed upon agricultural crops, browse, grasses, and forbs, but also consume mushrooms, acorns, fruits, and nuts (Colorado Division of Wildlife 2007, Utah Division of Wildlife Resources 2007). They often cause damage when browsing in winter on ornamental plants around homes (NatureServe 2007).

Pronghorn (Antilocapra americana). Pronghorn inhabit non-forested areas such as desert, grassland, and sagebrush habitats (BLM 2005b). Herd size can commonly exceed 100 individuals, especially during winter (BLM 2004a). They consume a variety of forbs, shrubs, and grasses, with shrubs being of most importance in winter (BLM 2004a). Some pronghorn are year-long residents and do not have seasonal ranges. Fawning occurs throughout the species range. However, some seasonal movement within their range occurs in response to factors such as extreme winter conditions and water or forage availability (BLM 2004a). Other pronghorn are migratory. Most herds range within an area 5 miles or more in diameter, although the separation between summer and winter ranges has been reported to be as much as 99 miles or more (NatureServe 2007). For example, in western Wyoming, pronghorn migrate 72 to 160 miles between seasonal ranges (Sawyer et al. 2005). Pronghorn populations have been adversely impacted in some areas by historic range degradation and habitat loss and by periodic drought conditions (BLM 2005b).

Bighorn Sheep (Ovis canadensis). Rocky Mountain bighorn sheep *(Ovis c. canadensis)* and desert bighorn sheep *(O. canadensis nelsoni)* are considered to be year-long residents within their ranges; they do not make seasonal migrations like elk and mule deer (BLM 2004a). However, they do make vertical migrations in response to an increasing abundance of vegetative growth at higher elevations in the spring and summer and when snow accumulation occurs in high-elevation summer ranges (NatureServe 2007).

Also, ewes move to reliable watercourses or water sources during the lambing season, with lambing occurring on steep talus slopes within one to two miles of water (BLM 2004a). Bighorn sheep prefer open vegetation such as low shrub, grassland, and other treeless areas with steep talus and rubble slopes (BLM 2004b). Unsuitable habitats include open water, wetlands, dense forests, and other areas without grass understory (NatureServe 2007).

The distribution of the bighorn sheep within the project area is mostly within the central north-to-south band of states. Their diet consists of shrubs, forbs, and grasses (BLM 2004a). In the early 1900s, bighorn sheep experienced significant declines due to disease, habitat degradation, and hunting (BLM 2005b). Threats to bighorn sheep include habitat changes due to fire suppression, interactions with feral and domestic animals, and human encroachment (NatureServe 2007). Bighorn sheep are very vulnerable to viral and bacterial diseases carried by livestock, particularly domestic sheep. Therefore, BLM has adopted specific guidelines regarding domestic sheep grazing in or near bighorn sheep habitat (BLM 2004a). In appropriate habitats, reintroduction efforts, coupled with water and vegetation improvements, have been conducted to restore bighorn sheep to their native habitat (BLM 2005b).

Moose (Alces americanus). Although moose range widely among habitat types, they prefer forest habitats where there is a mixture of wooded and open areas near wetlands and lakes (Utah Division of Wildlife Resources 2007). They are primarily browsers upon trees and shrubs such as willow, fir, and quaking aspen, although grasses, forbs, and aquatic vegetation are also consumed during spring, summer, and fall (BLM 2005b, Colorado Division of Wildlife, 2007). They generally occur singly or in small groups. Moose are active throughout day and night, but the peak periods of activity are near dawn and dusk (Utah Division of Wildlife Resources 2007). Some moose make short elevational or horizontal migrations between summer and winter habitats (NatureServe 2007).

Moose breed in late summer to early fall, with calving occurring in late spring (Utah Division of Wildlife Resources 2007). Moose habitat is thought to be improved by annual flooding and habitat management techniques such as prescribed burning (BLM 2005b). In addition to predation by wolves and bears, snow accumulation may have a controlling effect on moose populations. Habitat degradation due to high numbers of moose can lead to population crashes (NatureServe 2007).

American Bison (Bos bison). The American bison inhabits grasslands, semidesert shrublands, pinyon-juniper woodlands, and alpine tundra (Colorado Division of Wildlife 2007). They are grazers with grasses, sedges, and rushes comprising most of their diet (Colorado Division of Wildlife 2007). American bison are diurnal, being especially active during early morning and late afternoon. They have several grazing periods that are interspersed with periods of loafing and ruminating (NatureServe 2007). Within the project area, American bison are often found in managed herds that are often closely confined (Colorado Division of Wildlife 2007). Only a few remnant wild populations occur in US and Canadian national parks (NatureServe 2007). Pre-1900 herds migrated up to several hundred miles between summer and winter ranges, but herds that currently exist either make short migrations or do not migrate (Utah Division of Wildlife Resources 2007).

***Caribou (Rangifer tarandus*).** Caribou inhabit arctic tundra, subarctic taiga, mature coniferous forest, semi-open and open bogs, rocky ridges with jack pine, and riparian zones throughout all habitats. Migratory herds in Alaska winter in boreal forest and summer in tundra. Caribou are gregarious and in tundra form loose herds of about 1,000. Tundra caribou may travel extensively in summer in attempt to avoid bothersome insects (Eastland et al. 1989).

Caribou often incur high calf loss, mostly due to predation by wolves (Bergerud et al. 1984). The Porcupine Herd of northeastern Alaska give birth on patches of bare ground within snowfields (Eastland et al. 1989) and cows select areas north of the foothills (snow conditions permitting), thereby reducing exposure of calves to predators. In northeastern Alaska and adjacent Canada, first-year survival of calves was 51 percent; mean annual survival rate was 84 percent for adult females and 83 percent for adult males; and hunting mortality for the herd averaged 2 to 3 percent annually (NatureServe 2007).

American Black Bear (Ursus americanus). American black bear is found mostly within forested or brushy mountain environments and woody riparian corridors (Utah Division of Wildlife Resources 2007). They are omnivorous. Depending upon seasonal availability, they will feed on forbs and grasses, fruits and acorns, insects, small vertebrates, and carrion (Colorado Division of Wildlife 2007). Breeding occurs in June or July, with young born in January or February (Utah Division of Wildlife Resources 2007). American black bears are generally nocturnal, and have a period of winter dormancy (Utah Division of Wildlife Resources 2007). They are locally threatened by habitat loss and disturbance by humans (NatureServe 2007). The home range size of American black bears varies depending on area and gender and has been reported to be from about 1,250 to nearly 32,200 acres (NatureServe 2007).

Grizzly Bear (Ursus arctos). Brown bear are found mostly in arctic tundra, alpine tundra, and subalpine mountain forests. They were once found in a wide variety of habitats, including open prairie, brushlands, riparian woodlands, and semidesert scrub, but have since been extirpated these areas. Sustainable populations require huge areas of suitable habitat (Craighead 1976). Diet is highly variable and consists of fruits, nuts, large and small mammals, fish, insects, and tuberous roots. Grizzly bears are common only where food is abundant and concentrated (e.g., salmon runs, caribou calving grounds). Grizzly bears become dormant during the winter. Young are born in the den and emerge in spring (NatureServe 2007).

Cougar (Puma concolor). Cougars (also known as mountain lions) inhabit most ecosystems in the project area, but are most common in the rough, broken terrain of foothills and canyons, often in association with montane forests, shrublands, and pinyon-juniper woodlands (Colorado Division of Wildlife 2007). They mostly occur in remote and inaccessible areas (NatureServe 2007). Their annual home range can be more than 560 square miles, while densities are usually not more than 10 adults per 100 square miles (NatureServe 2007). The mountain lion is generally found where its prey species (especially mule deer) are located. In addition to deer, they prey upon most other mammals (which sometimes include domestic livestock) and some insects, birds, fishes, and berries (Colorado Division of Wildlife 2007). They are active year round. Their peak periods of activity are within two hours of sunset and sunrise, although their activity peaks after sunset when they are near humans (NatureServe 2007, Utah Division of Wildlife Resources 2007). They are hunted on a limited and closely monitored basis in some states (BLM 2004a, NatureServe 2007).

3.10.2 Climate Change

Changes in climate can influence the timing and length of seasons, which in turn can have a direct effect on plants and animals. This includes changes in ranges, abundances, phenology (timing of an event such as breeding), morphology and physiology, and community composition, biotic interactions, and behavior. Changes are being seen in all different types of taxa, from insects to mammals, in North America as well as on many other continents.

3.11 THREATENED, ENDANGERED AND SPECIAL STATUS SPECIES

In the project area, there are over 2,000 species considered threatened, endangered, or of special concern at national, regional or state level (all referred to as special status) occurring on or near public and NFS lands (Table 3-22), Plants, Invertebrates, Fish, and Wildlife Listed under the Endangered Species Act Occurring on or near Public and NFS Lands in the Project Area). Species considered special status are either federally listed as threatened or endangered under the Endangered Species Act (see below), are proposed for future listing, or considered special status by the BLM, FS, or individual states programs. The number of species considered for special status is dynamic and could change throughout the time period considered by the PEIS. The number of special status species occurring in the planning area cannot be accurately accessed because species occurrences are not always reported or known, species can be rare, location and accurate range are not always well defined, and habitats may change over time. For the purposes of this analysis, it is assumed that all special status species that occur in the project area would have the potential to occur in the planning area.

Table 3-22
Plants, Invertebrates, Fish, and Wildlife Listed under the Endangered Species Act Occurring on or near Public and NFS Lands in the Project Area

State	Plants	Invertebrates	Fish	Amphibians	Reptiles	Mammals	Birds
Endangered							
Alaska	1	-	-	-	1	4	2
Arizona	11	1	8	1	-	8	6
California	134	26	15	6	3	29	11
Colorado	6	1	4	-	-	2	4
Idaho	-	4	2	-	-	3	1
Montana	-	-	2	-	-	2	3
Nevada	2	1	17	-	-	1	1
New Mexico	7	7	6	-	-	4	4
Oregon	9	1	4	-	1	6	4
Utah	11	1	7	-	-	2	2
Washington	3	-	1	-	1	7	3
Wyoming	-	-	5	1	-	2	1
Threatened							
Alaska	-	-	-	-	-	3	2
Arizona	6	-	8	1	1	1	1
California	45	6	15	2	8	4	6
Colorado	7	1	1	-	-	3	2

Table 3-22
Plants, Invertebrates, Fish, and Wildlife Listed under the Endangered Species Act Occurring on or near Public and NFS Lands in the Project Area

State	Plants	Invertebrates	Fish	Amphibians	Reptiles	Mammals	Birds
Idaho	4	1	4	-	-	3	-
Montana	3	-	1	-	-	2	1
Nevada	7	1	5	-	1	1	-
New Mexico	6	-	7	1	1	1	1
Oregon	6	2	15	-	2	4	3
Utah	13	-	1	-	1	3	1
Washington	6	1	14	-	-	4	3
Wyoming	3	-	-	-	-	3	-
Candidate							
Alaska	1	-	-	-	-	-	1
Arizona	3	4	2	1	1	-	1
California	10	3	-	3	-	2	2
Colorado	6	-	1	-	-	-	2
Idaho	2	-	-	-	-	1	1
Montana	1	1	-	-	-	-	1
Nevada	4	1	-	3	-	-	1
New Mexico	-	4	2	-	1	-	2
Oregon	2	2	-	1	-	2	3
Utah	1	3	-	1	-	-	1
Washington	5	2	-	1	-	10	3
Wyoming	1	-	-	-	-	-	1

Source: USFWS 2008

Special status aquatic animal species are found on public lands throughout the US. A number of listed salmon populations are found in rivers in the Pacific Coast states. In arid habitats, many special status fish species are found in the rare and fragile desert wetlands and springs, as well as in major rivers such as the Colorado and the Rio Grande. In the deserts of the Great Basin and Colorado Plateau, terminal lakes, marshes, and sinks provide important habitats for special status fish species that are adapted to their warm, saline conditions. Special status mollusk species occur predominantly in the Snake River of Idaho and in thermal habitats and small springs and wetlands in New Mexico, Arizona, and Utah. Aquatic arthropods of special status occur predominantly in the vernal pools of California. Special status terrestrial arthropods are largely butterflies that occur mostly in open habitats. Special status amphibians occur in wetland habitats throughout the west, and special status reptiles occur in warm habitats of California and the southwest. Special status birds and mammals use a wide range of habitats found on public and NFS lands throughout the project area.

3.11.1 Endangered Species Act

The Endangered Species Act (ESA) was passed in 1973 to address the decline of fish, wildlife, and plant species in the US and throughout the world. The purpose of the ESA is to conserve "the ecosystems upon which endangered and threatened species depend" and to conserve and recover listed species (ESA 1973, Section 2). The law is administered by USFWS and the US Department of Commerce, National Marine Fisheries Service (NMFS). The USFWS has primary responsibility for terrestrial and freshwater organisms, while the NMFS is primarily responsible for marine species such as salmon and whales.

Under the ESA, species may be listed as either endangered or threatened. The ESA defines an endangered species as any species that is in danger of extinction throughout all or a significant portion of its range (ESA 1973, Section 3[6]). A threatened species is one that is likely to become an endangered species within the foreseeable future throughout all or a significant part of its range (ESA 1973, Section 3[20]). All species of plants and animals, except pest insects, are eligible for listing as endangered or threatened. The ESA also affords protection to critical habitat for threatened and endangered species. Critical habitat is defined as the specific areas within the geographical area occupied by the species at the time it is listed, on which are found physical or biological features essential to the conservation of the species and which may require special management considerations or protection (ESA 1973, Section 3[5][A and B]). Except when designated by the Secretary of the Interior, critical habitat does not include the entire geographical area that can be occupied by the threatened or endangered species (ESA 1973, Section 3[5][C]).

Species may also be candidates for listing (ESA 1973, Section 6[d][1] and Section 4[b][3]). The USFWS defines proposed species as any species that is proposed in the *Federal Register* to be listed under Section 4 of the ESA. Candidate species are those for which USFWS has sufficient information on their biological status and threats to propose them for listing as endangered or threatened under the ESA, but for which development of a listing regulation is precluded by other higher priority listing activities (USFWS 2004a). The NMFS defines candidate species as those proposed for listing as either threatened or endangered or whose status is of concern, but for which more information is needed before they can be proposed for listing. Candidate species receive no statutory protection under the ESA, but by definition these species may warrant future protection under the ESA.

Federally listed species that could occur in the project area are included in Appendix H.

BLM Special Status Species Policy

On public lands, the BLM is required to manage plant and wildlife species that are listed or proposed under the ESA, which has nine sections containing requirements or authorizations that apply to the BLM (ESA Sections 2, 4, 5, 6, 7, 9, 10, 11, and 18). These are addressed in BLM Manual 6840 — Special Status Species Management (BLM 2001), which establishes special status species policy for plant and animal species and the habitats on which they depend. The policy refers not only to species listed under the ESA, but also to those designated by the BLM State Director as sensitive. BLM Manual 6840 defines a sensitive species as a species that could easily become endangered or extinct in the state. Criteria in BLM Manual 6840 for designating a species as sensitive are as follows:

- The species is under ESA status review by the USFWS or NMFS;
- The numbers of individuals of the species are declining so rapidly that federal (ESA) listing may become necessary;
- The species has typically small or widely dispersed populations; or
- The species inhabits an ecological refugium or other specialized or unique habitat.

Under BLM Manual 6840, the BLM is required to use other agencies' lists (such as threatened and endangered lists, watch lists, and species of concern lists issued by various state and federal agencies) (Table 3-23, Plant, Invertebrate, and Fish and Wildlife Considered BLM Special Status in the Project Area). For example, the BLM Utah State Office currently uses the Utah Division of Wildlife Resources' sensitive animals list as the BLM list. The number of sensitive species varies across the project area BLM State Offices (Table 3-23, Plant, Invertebrate, and Fish and Wildlife Considered BLM Special Status in the Project Area). Similarly, which species may occur at a geothermal energy development project in the planning area would depend on the particular state in which the project is located, the species list for that state, and the specific location (and associated habitats) of the proposed project, and would need to be addressed in the site-specific environmental analysis.

Forest Service Threatened, Endangered & Sensitive Species Program

The Threatened, Endangered & Sensitive Species Program is the Forest Service's dedicated initiative to conserve and recover plant and animal species that need special management attention and depend on National Forest and Grassland habitats. In addition to contributing to the recovery of threatened and endangered species, the Forest Service management also conserves habitat for some 3,250 sensitive species. These are species listed by the FS as needing special management to maintain and improve their status on National Forest and Grasslands, and prevent a need for listing under the ESA.

Table 3-23
Plant, Invertebrate, and Fish and Wildlife Considered BLM Special Status in the Project Area

State	Plants	Invertebrates	Fish	Amphibians	Reptiles	Mammals	Birds
Alaska	33	-	6	-	-	2	26
Arizona	44	24	7	-	13	9	2
California	497	13	4	8	11	21	9
Colorado	79	1	4	5	6	4	11
Idaho	161	21	21	8	7	29	50
Montana	98	-	10	6	5	15	29
Nevada	116	74	46	3	7	33	34
New Mexico	179	27	23	6	15	22	32
Oregon	457	59	38	12	2	20	36
Utah	101	28	22	4	13	19	19
Washington	196	2	8	2	4	20	20
Wyoming	37	-	8	4	1	9	13

Source: Alaska Natural Heritage Program 2007; Arizona Game and Fish Department 2007; BLM 2002, 2004a, 2004b, 2006b, 2007c, 2007d, 2007e; Colorado Natural Heritage Program 2007; Keinath et al. 2003; Montana Natural Heritage Program 2006, 2007; New Mexico Department of Game and Fish, Conservation Services Division 2006; New Mexico Rare Plant Technical Council 2005; Nevada Natural Heritage Program 2007; Utah Department of Natural Resources, Division of Wildlife Resources 2006.

The FS Threatened, Endangered & Sensitive program involves a variety of activities conducted by the FS and government, educational, and private organization partners. These include inventory and monitoring, habitat assessments, habitat improvements through land treatments and structure installation, species reintroductions, development of conservation strategies, research, and information and education (FS 2007a). Table 3-24, US Forest Service Special Status Species by Project Area State, provides the numbers of FS plant and wildlife species listed under the program.

State-listed Species

Each of the project area states also has species identified that are of state concern. Some species are listed per a specific definition and afforded protection and/or management under a state regulation. Other species are on some form of watch list; these species are tracked with regard to their abundance and distribution within a state by organizations, such as the state Natural Heritage Program. The species that occur on public or NFS lands in the planning area and that may be affected by a specific geothermal energy development project would depend upon the location of that particular project, and would need to be addressed in the site-specific environmental analysis.

Table 3-24
US Forest Service Special Status Species by Project Area State

State	Plants	Invertebrates	Fish	Amphibians	Reptiles	Mammals	Birds
Alaska	19	-	3	-	-	1	5
Arizona	129	30	10	8	14	47	36
California	377	14	23	20	13	14	9
Colorado	61	5	9	4	1	9	21
Idaho	75	-	5	3	1	5	10
Montana	104	-	6	5	3	14	14
Nevada	96	3	7	2	1	5	7
New Mexico	65	41	14	8	10	54	38
Oregon[1]	428	61	12	12	7	12	25
Utah							
Washington[1]	288	43	13	10	7	13	23
Wyoming	63	-	12	5	1	13	26

[1]For USFS areas spanning more than one state, species are counted under both states when not indicated by USFS which specific state they are found.

Source: Colorado Natural Heritage Program 2007; Keinath *et al.* 2003; Martin 2007; Montana Natural Heritage Program 2006; FS 2000, 2001, 2004b, 2007a, 2007b, 2007c, 2007d, 2007e

3.11.2 Threats to Special Status Species

A variety of factors affect endangered, threatened, and special status species. Some threats are greater for certain taxa or ecosystems, while others, including habitat loss from urbanization and agricultural development, have a wide-spread potential effect. Habitat loss is a primary threat to species and reason for their decline. The loss of suitable habitat is the result of one or more factors, including both direct human impact through urbanization and land and water use and global and regional climate change (McKinney 2002). Invasive species and genetic hybridization can also adversely affect sensitive species.

Land use is also a primary influence on species decline. Urbanization, logging, mining, water diversion, agriculture, and recreation have all historically affected populations of native plants and animals. Land use can reduce and fragment habitat (Donovan and Flather 2002, NatureServe 2008, Newlon 2005). Fragmentation of forests results in reduced habitat for territorial species such as the brown bear *(Ursus arctos)*, which require large home ranges (Campbell 1999). Indirect effects of various land uses include road construction and erosion, which can increase the effect on waterways and riparian habitats and can fragment terrestrial habitats. Land use can result in the introduction of nonnative species and the need for diversion of water for irrigation, and efforts to control potential threats to crops and livestock with the use of chemicals can affect species. Endangered native bunchgrass and sagebrush communities have been diminished by the invasion of introduced species and historical clearing of land for agricultural use. Species that are obligate to these communities, such as the state-listed Gunnison sage grouse *(Centrocercus minimus)*, have consequently experienced population decreases (Johnson, Jr. 2007, NatureServe 2008, USFWS 2004b). In drier ecoregions, such as temperate and sub-tropical desert and steppe, federally endangered Devil's Hole pupfish *(Cyprinodon diabolis)* and other desert organisms endemic to isolated permanent aquatic habitats have historically been threatened by the diversion of water (NVDCNR 2007).

Climate change has a disproportionate effect on special status species. Based on analysis of temperature and precipitation data from the 20th century and models on continued climate change patterns, it is anticipated that global temperatures will continue to rise and weather patterns will become increasingly erratic. This trend is anticipated to result in ongoing increases in precipitation in historically wetter ecoregions and further reduced precipitation in historically drier ecoregions. The broad implications of these changes affect all species but are specifically detrimental to highly specialized species (Diaz 2004, Joyce et al. 2007).

As climate change continues, wetter ecoregions, such as the subarctic and marine, will experience increased levels of precipitation. The increased moisture in these habitat areas will result in greater vegetative biomass and reduced desert habitat. This has the potential to encourage distribution and heighten population levels of invasive plant species, particularly in historical desert areas where native species may be less tolerant of increased precipitation. Desertification has already contributed to the decline of sagebrush and bunchgrass habitat and associated species.

Invasive species are those that are not historically native to a habitat or region. Often they are introduced purposefully for agricultural use, hunting, pest control, or aesthetic purposes. Other times they are unintentionally introduced, traveling in the bilge water of transoceanic ships, shipping containers, or on the wheels and insides of cars. Or they may arrive through accidental release from captivity. The three major threats from nonnative species are competition, predation, and hybridization.

Plant communities may be dramatically altered by the invasion of nonnative species. Sagebrush habitat has been overcome by cheatgrass *(Bromus spp.)*, an invasive plant found in every US state (Chambers et al. 2005, Pendleton et al. 2007, USFWS 2004b). Competition for nonnative species also impacts wildlife. Accidental release of brown trout into federally threatened native bull trout habitat has created competition for food sources (Epifanio et al. 2003).

Predation by non-native species is a common threat to sensitive species of birds, aquatic invertebrates, amphibians and small mammals that have evolved defensive tactics against certain types of predation. Frequently the threat of predation by non-native species is compounded by threats from urbanization and other land use activities.

The threat of hybridization, the process of cross-breeding two closely-related species, is the dilution of the sensitive population's gene pool to the point at which the sensitive species is no longer distinct. Hybridization is not always successful in producing a viable mixed-gene population. The progeny of two distinct species can be sterile, increasing the rate of population decline in the sensitive species (USFWS 2007b).

3.11.3 Climate Change

Changes in climate can influence the timing and length of seasons, which in turn can have a direct effect on threatened and endangered species and their habitat. This may include changes in ranges, abundances, phenology (timing of an event such as reproduction), morphology and physiology, and community composition, biotic interactions, and behavior. Changes are being seen in all different types of taxa, from insects to mammals, in North America as well as on many other continents.

3.12 WILD HORSES AND BURROS

The BLM, in conjunction with the FS, manages wild horses and burros on BLM- and FS-administered lands through the Wild Free Roaming Horse and Burro Act of 1971. Animals are managed within 199 herd management areas with the goals of maintaining the natural ecological balance of public lands and the ability to support multiple herds (BLM 2007h). Herd population management is important for balancing herd numbers with forage resources and other uses of public and adjacent private lands (BLM 2004c, d). Wild horses that are found outside of herd management areas are considered excess and are subject to annual removal. Removed animals are made available for adoption. Unadoptable individuals are destroyed in the most humane manner possible (BLM 2004c). On average, a herd of 10 wild horses or burros uses about 3,600 acres, with most herd management areas occupying 10,000 to 100,000 acres or more (BLM 2007h). Annual home range (the area habitually occupied by a herd over the course of a year) is usually less than 6,178 acres but may be as large as 74,132 acres (NatureServe 2007). As wild horse numbers within a herd can increase up to 25 percent annually, they can affect the condition of their range and increase competitive pressure among wild horses, livestock, and wildlife. Therefore, wild horse and burro herd size is maintained through gathers that are performed every three to five years. A gather is a roundup of wild horses and burros, usually conducted by helicopter. Once gathered, a specialist loads the animals onto trucks for transport to a holding area at the gather site where determinations are made about which animals will be returned to the range and which will be sent to a BLM preparation facility. Gathered horses and burros sent to a BLM preparation facility are placed for adoption through the Wild Horse and Burro Adoption Program or otherwise placed in long-term holding facilities. The BLM is currently researching the use of immuno-contraceptives to slow the reproductive rate of wild horses and burros (BLM 2004d). Issues that make wild horse and burro management difficult include:

- Competition between large game animals (elk, deer, antelope) and horses;
- Herd management areas located within areas where critical soils (i.e., soils that pose salinity problems and/or are very susceptible to erosion) make up more than 50 percent of the area;
- Competition with livestock; and
- Illegal chasing, capturing, and harassment (BLM 2004d).

Wild horses generally occur in common social groups of several females that are led by a dominant male. Young males are expelled from the social group when they are one to three years old and form bachelor groups (NatureServe 2007). They feed on grass and grass-like plants and browse on shrubs in winter. They visit watering holes daily and may dig to water in dry river beds (NatureServe 2007). Wild horses also tend to dominate water sources, driving wildlife away

(BLM 2004b). They are sometimes regarded as a pest because they can foul water, compete with livestock, or displace native ungulates such as pronghorn and bighorn sheep (NatureServe 2007).

Table 3-25 summarizes the wild horse and burro statistics for the project area for fiscal year 2007. Ten of the 12 western states (there are no herds in Alaska or Washington) have a total of 28,563 wild horses and burros, although the appropriate management level (i.e., the maximum number of animals sustainable on a year-long basis) is considered only 27,492 animals (BLM 2007h).

3.12.1 Climate Change

As discussed in Section 3.6 Soils and Section 3.9 Vegetation, climate change can affect both the soils and vegetation that wild horses and burros depend upon for food and habitat. As mentioned above, changes in soil stability increase the challenges with the management of wild horses and burros, particularly when more than 50 percent of the areas on which they are located already have soil issues. Changes in vegetation can pose either advantages or challenges for wild horses and burros in meeting their nutritional requirements, depending on what changes in vegetation occur.

Table 3-25
Project Area Wild Horse and Burro Statistics (Fiscal Year 2007)

State	Herd Areas			Herd Management Areas				Populations			
	BLM Acres	Other Acres	Total Acres	No. Herd Management Areas	BLM Acres	Other Acres	Total Acres	Horses	Burros	Total	Total Appropriate Management Level
Alaska[1]	-	-	-	-	-	-	-	-	-	-	-
Arizona	2,019,932	1,617,998	3,637,930	7	1,756,086	1,327,777	3,083,863	215	1,501	1,716	1,600
California	5,112,778	1,851,661	6,964,439	22	1,946,590	471,855	2,418,445	2,478	635	3,113	2,199
Colorado	658,119	76,572	366,098	4	366,098	38,656	404,754	771	0	771	812
Idaho	428,421	49,235	477,656	6	377,907	40,287	418,194	803	0	803	617
Montana	104,361	119,242	223,603	1	28,282	8,865	37,147	154	0	154	105
Nevada	19,593,299	3,088,027	22,681,326	102	15,778,284	1,695,925	17,474,209	12,467	528	12,995	13,485
New Mexico	88,653	37,874	126,527	2	24,505	4,107	28,612	89	0	89	83
Oregon	3,559,935	785,250	4,345,185	18	2,703,409	259,726	2,963,135	2,092	15	2,107	2,715
Utah	3,236,178	689,176	3,925,354	21	2,462,726	374,614	2,837,340	2,543	195	2,738	2,151
Washington[1]	-	-	-	-	-	-	-	-	-	-	-
Wyoming	7,297,778	3,030,010	10,327,788	16	3,638,330	1,137,121	4,775,451	4,077	0	4,077	3,725
Total	42,099,454	11,345,045	53,444,499	199	29,082,217	5,358,933	34,441,150	25,689	2,874	28,563	27,492

[1] No horse or burro herds are present in Alaska or Washington.

Source: BLM 2007H

3.13 LIVESTOCK GRAZING

The primary laws that govern grazing on public lands are the Taylor Grazing Act of 1934, the FLPMA, and Public Rangelands Improvement Act of 1978. The three enabling statutes that govern grazing on NFS lands are the Organic Administration Act, the Bankhead-Jones Farm Tenant Act, and the Multiple-Use Sustained-Yield Act.

The Taylor Grazing Act directs that occupation and use of the range be regulated to preserve the land and its resources from destruction or unnecessary injury, and to provide for the orderly use, improvement, and development of the range. FLPMA provides authority and direction for managing federal lands on the basis of multiple use and sustained yield and mandates land use planning principles and procedures for federal lands. The Public Rangelands Improvement Act does the following:

- Defines rangelands as public lands on which there is domestic livestock grazing or that are suitable for livestock grazing;
- Establishes a national policy to improve the condition of public rangelands so they will become as productive as feasible for all rangeland values;
- Requires a national inventory of public rangeland conditions and trends; and
- Authorizes funding for range improvement projects.

The BLM manages rangelands on public lands under 43 CFR Part 4100 and BLM Handbooks 4100 to 4180. The BLM conducts grazing management practices through BLM Manual H-4120-1 (BLM 1984). The FS primarily manages grazing and management on NFS lands under 36 CFR 222, Forest Service Manuals (FSM 2200 – Range Management), and Forest Service Handbooks (FSH 2200 – Range Management) (FS 2007f). Under this management, ranchers may obtain a grazing permit for an allotment of public or NFS land on which a specified number of livestock may graze. An allotment is an area of land designated and managed for livestock grazing. The number of permitted livestock on a particular allotment on public land is determined by how many animal unit months that land will support. An animal unit month is the quantity of forage required by one mature cow and her calf (or the equivalent in sheep or horses) for one month. Upper and special limits governing the total number of livestock for which a person is entitled to hold a grazing permit on NFS lands is determined by the Chief of the Forest Service based factor identified in 36 CFR 222.

Approximately 154,897,988 acres of public and 103,129,814 acres of NFS lands are grazed in the project area. Approximately 125,131,307 acres of public and 70,187,293 acres of NFS lands are grazed in the planning area. Table 3-26 lists

Table 3-26
Livestock Grazing Permits, Leases, and Active Animal Unit Months on Public Lands in the Project Area (Fiscal Year 2006)

State	Leases and Permits	Active AUMs	Receipts form Leases, Licenses and Permits
Alaska*	0	0	$0
Arizona	757	660,007	$693,917
California	548	355,726	$318,202
Colorado	1,591	650,168	$649,238
Idaho	1,890	1,348,526	$1,619,808
Montana	3,755	1,281,144	$2,027,960
Nevada	644	2,137,635	$2,277,130
New Mexico	2,275	1,856,795	$2,104,970
Oregon	1,277	1,026463	$1,332,862
Utah	1,499	1,239,786	$1,236,951
Washington	283	33,603	$49,166
Wyoming	2,792	1,960956	$2,332,290
Total	**17,311**	**12,550,809**	**$14,642,494**

* Data does not include reindeer grazing permits. There are approximately 11 case files with open permits issued by the BLM . There are approximately 7.134 animals currently grazing.
Source: BLM 2006c

Table 3-27
Authorized Livestock Permits and Active Animal Unit Months on National Forest System Lands[1] in the Project Area (Fiscal Year 2005)

State	Permits	Active AUMs
Alaska	0	0
Arizona	392	592,856
California	413	381,047
Colorado	710	774,533
Idaho	765	703,784
Montana	802	458,890
Nevada	134	226,066
New Mexico	672	522,065
Oregon	294	341,193
Utah	815	543,670
Washington	108	81,135
Wyoming	463	616,871
Total	**5,568**	**5,242,110**

[1] Forest Service System Lands include National Forests, National Grasslands, Land Utilization Projects, and other federal lands for which the FS has administrative jurisdiction.
Source: FS 2006b

grazing statistics on public lands within the project area. The total number of grazing permits/leases on public lands in the project area was 17,311, with a total of 12.6 million animal unit months authorized. These grazing authorizations produced approximately $14.7 million in grazing fees (BLM 2006c).

Within the planning area approximately 10,138,925 AUMs are available within 125,131,307 acres of public land, and approximately 3,303,980 AUMs are available within 70,187,293 acres of NFS lands.

3.13.1 Climate Change

The consequences of weather and climate change on livestock grazing and grassland use can be subtle and complex. The projected changes in climate–increases in temperature, reductions in soil moisture, and more intense rainfall events–may require changes in livestock management. The availability of feed and water for livestock grazing is extremely vulnerable to drought; hence, the carrying capacity of land may influence livestock management.

3.14 CULTURAL RESOURCES

Cultural resources are past and present expressions of human culture and history in the physical environment and include prehistoric and historic archaeological sites, structures, natural features, and biota that are considered important to a culture, subculture, or community. Cultural resources also include aspects of the physical environment that are a part of traditional lifeways and practices and are associated with community values and institutions. These traditional cultural resources are addressed in a separate chapter on ethnographic resources and tribal trust assets (Chapter 3.15). Cultural resources addressed in this section include the physical remains of prehistoric and historic cultures and activities, such as archaeological sites, historic trails, and boom towns. Historic properties are a subset of these kinds of cultural resources that meet specific eligibility criteria found at 36 CFR 60.4 for listing on the National Register of Historic Places (NRHP).

In this chapter, cultural resources are discussed according to established culture regions: Alaska (Arctic and Subarctic), California, Great Basin, Great Plains, Northwest Coast, Plateau, and Southwest. These are regions where there is continuity across the landscape in cultural adaptations, traditions, environment, and habitats. For consistency, maps defining these regions and the cultural groups within them are derived from the respective volumes of the Smithsonian Handbook of the American Indian and reflect the choices of the authors and editors of this series. These maps generally depict territorial assumptions existing at the approximate time of Native contact with Euro-Americans and may not encompass territorial ranges or ancestral lands as recognized by tribes or archaeologists. For example, important Ancestral Puebloan occupations in Southwestern Colorado are found outside of the tribal ranges for the Southwest region. This is a programmatic level overview and should not be considered a detailed source for the extent of regional cultural influence or tribal interest.

Culture resources of these regions have been organized into prehistoric and historic resources. Prehistoric resources refer to any material remains, structures, and items used or modified by people before Euro-Americans established a presence in the region. Historic resources include material remains and the landscape alterations that have occurred since the arrival of Euro-Americans.

Appendix I provides detailed discussions of the prehistoric and historic cultural resources and patterns of these regions. Within each region's discussion, a table is provided to indicate the languages spoken by ethnographically recorded tribes. Discussions of prehistory within each region are focused on chronological periods that have been established based on the region's prehistoric archaeology. It should be noted that for many of these regions, there are area-specific culture chronologies that have been developed where cultural practices were unique within the larger region. Discussion of such specific time periods is avoided given the programmatic nature of this document and for ease of discussion. Although the culture regions are most appropriately applied to prehistoric populations, historic period resources are also organized by these culture regions for the ease of discussion. Discussions of the history within each region are organized by overall themes of the region. This includes such things as westward expansion, transportation, and mineral development. Because this approach leads to a very general discussion of the culture regions, an effort was made to coordinate with the BLM and FS field, regional, and district offices within the planning area to identify areas sensitive for cultural resources. The discussions in this section are based on the larger overview provided in Appendix I.

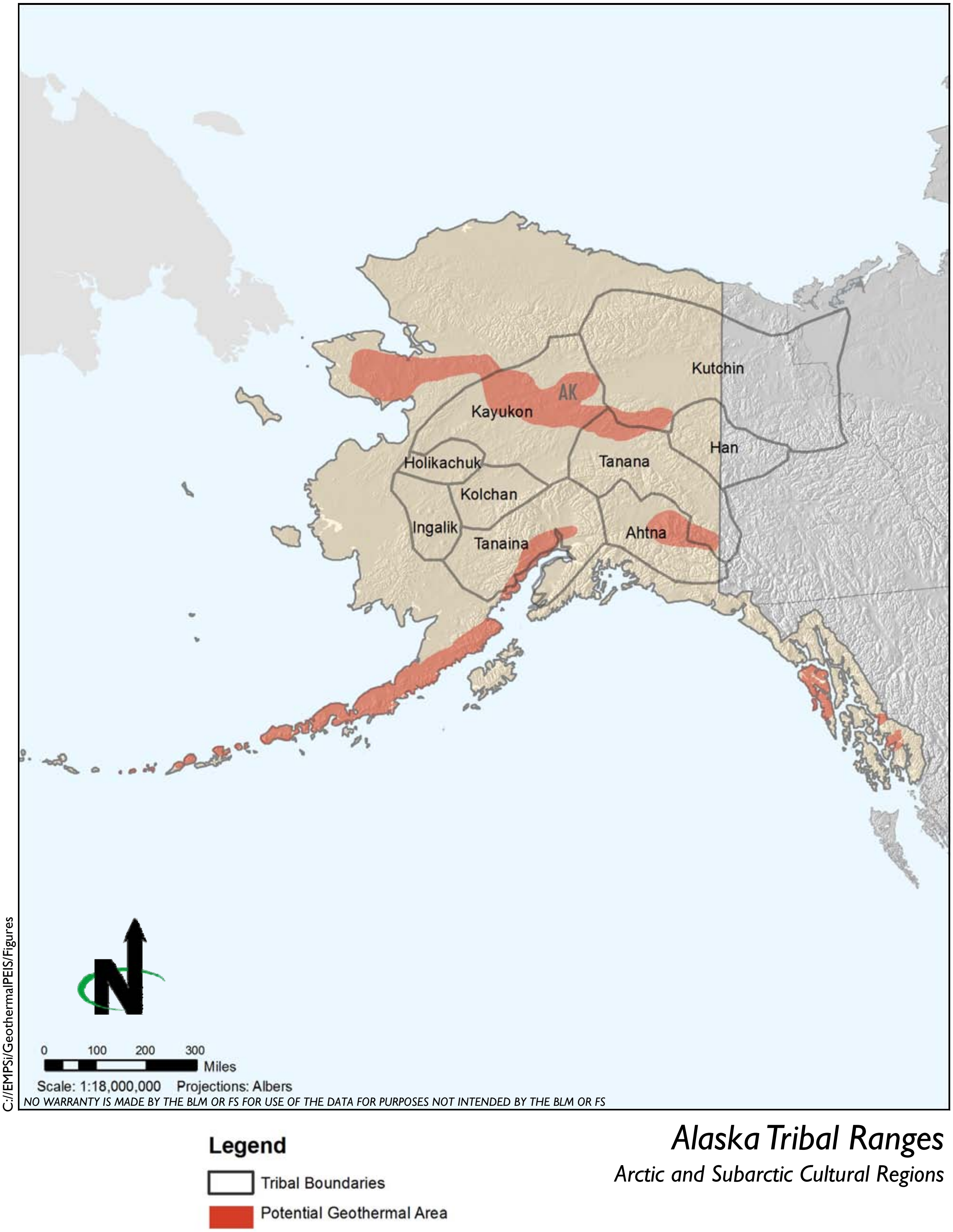
3.14.1 Alaska (Arctic and Subarctic)

Alaska is divided into two culture regions, the Arctic and Subarctic, which are combined into the Alaska culture region for purposes of this discussion (Figure 3-15 – Alaska [Arctic and Subarctic Culture Regions] Tribal Ranges). Within the project area, the Alaska culture region includes most of FS Region 10 and all or portions of the western BLM Field Offices.

Much of Alaska was ice free during the last glacial period, and the archaeology of the area is considered likely to provide important information pertaining to early North American human settlement. However, Pre-Clovis evidence for occupation of Alaska is debatable, and the early coastline has been greatly altered from rising sea levels. The earliest agreed-upon evidence is for a microblade tradition in the Paleoindian Subarctic, similar to that of the Archaic Northwest Coast (Neusius and Gross 2007).

Many of the later prehistoric cultural traditions outlined in Appendix I still occur in modern times within contemporary populations of Alaska. Based on the discussed prehistoric patterns, expected prehistoric sites of the region include isolated fluted points, lithic scatters, shell middens, burials, village sites, camp sites, and resource procurement sites. Most are expected to be situated along the coastline to facilitate marine mammal hunting, rivers to facilitate fishing, and inland in areas that produce game and plants. There are exceptions to this distribution pattern given regional variability.

Historic Alaska witnessed early Russian, Spanish, and English exploration and fur trading, bringing early contact with Native Alaskans. Other historic period activities include commercial whaling and fishing, missionization, gold mining, oil development, railroad construction, and development of other transportation-related routes. Historic-era sites expected within the region include early exploration settlements and camps; trading posts; whaling and salmon fishing facilities and communities; mineral mining, mineral development sites, and transport appurtenances such as pipelines, railroad tracks, and associated boom towns; and trails and associated towns.



Alaska Tribal Ranges

Arctic and Subarctic Cultural Regions

Figure 3-15

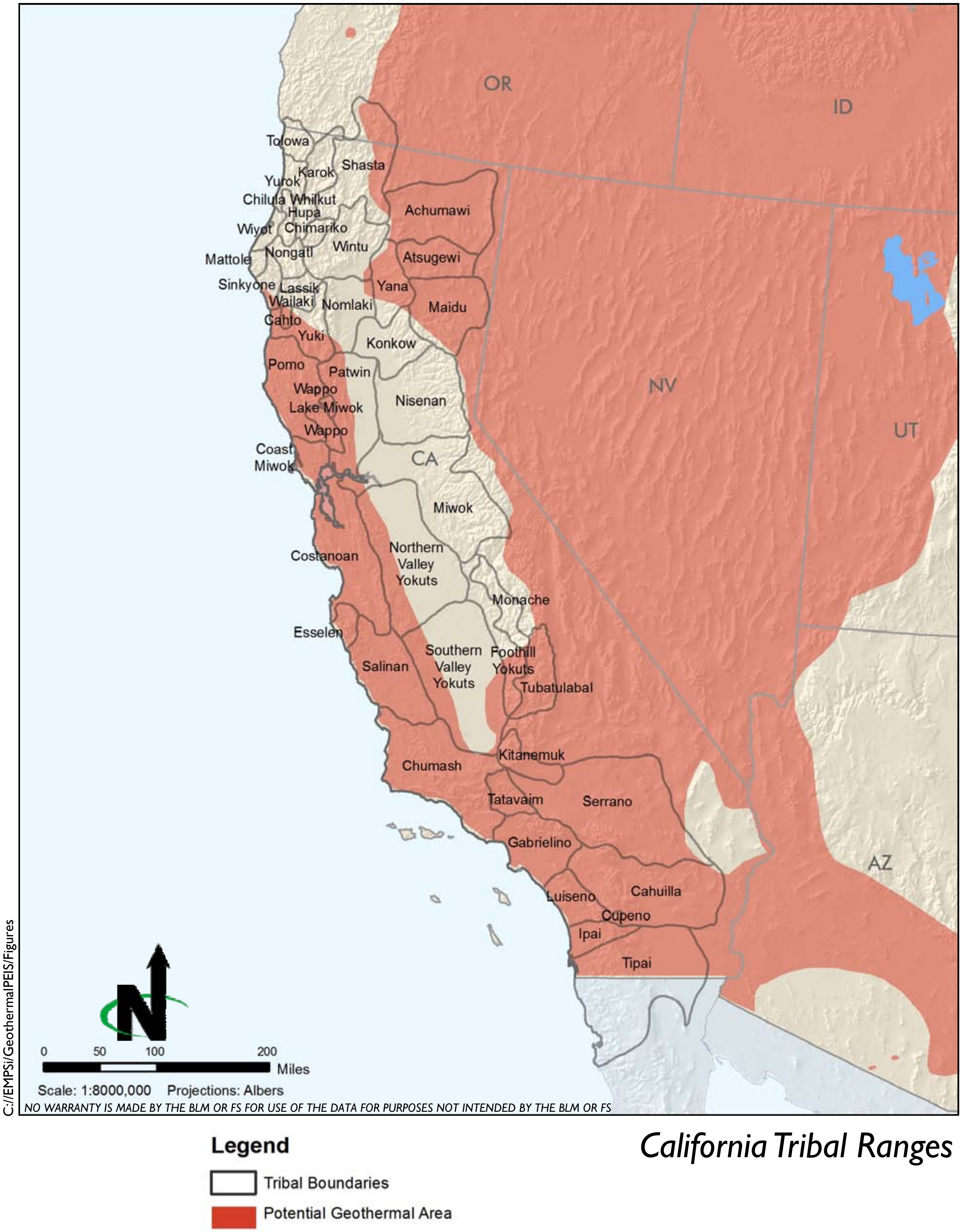
3.14.2 California

The California culture region resembles the modern state; however, it excludes parts of the northwest and northeast corners of the state (Northwest Coast and Plateau culture regions, respectively), as well as the Mojave Desert and areas east of the Sierra Nevada (Great Basin culture region) (Figure 3-16 – California Tribal Ranges). Within the project area, the California culture region includes all of FS Region 5 and a small southern portion of FS Region 6 in Oregon and all or portions of the western BLM Field Offices.

The early prehistory of California has been dramatically affected by post-glacial sea level rise, resulting in coastline inundation and coastal environment alteration. Consequently, any sites formed during the Paleoindian period along the now-submerged coastline would also be submerged or eroded. Additionally, the coastal environments would have been different than what they are today, making it difficult to assign sensitivity for cultural resources based solely on modern coastal environments.

Some of the earliest sites of the California culture region are isolated lithics and lithic scatters found on ground surfaces. A series of such sites have been found along the coastline and associated with coastal rivers, lagoons, and estuaries; a pattern for sites that continued through later periods. Other site types expected in the California region include shell middens, permanent village sites with pithouses, large and small seasonal base camps, smaller seasonal camps, specialized resource procurement sites (such as quarries, rock art, petroglyphs, pictographs, and bedrock milling stations), and cemeteries. Site occurrence can be most expected along the coast on higher ground, such as bluffs and marine terraces, at lagoons and estuaries, along the open coast at permanent bays and wetlands, along creeks and rivers, and in the foothills and mountains.

The largest effect on the Native American populations of California was missionization by the Spanish, who established missions, presidios, and pueblos (towns), primarily along coast and adjacent inland valleys. This affected social organization and subsistence activities of prehistoric populations. Early Euro-American exploration of the California culture region was done not only by the Spanish, but also by Britons, Russians, Mexicans, and later, Americans. Large numbers of Chinese later emigrated to the region, often establishing separate camps and small enclaves across the region. Major historic industries of the region included mining, agriculture, ranching, and railroad construction. Trails and transportation routes were also established and used by the early explorers, emigrants, and industries. Site types to be expected based on these activities include exploration camps, early settlements, Chinese camps and towns, missions, presidios, pueblos, ranches, farms, mines, mining camps, and railroads and trails with their associated boom towns.



California Tribal Ranges

Figure 3-16

3.14.3 Great Basin

The cultural region of the Great Basin is based on the hydrographic region of the same name, but is extended to include the area between the Sierra Nevada and the Rocky Mountains (Figure 3-17 – Great Basin Tribal Ranges). Within the project area, the Great Basin culture region includes portions of FS Regions 1 through 6 and all or portions of the western BLM Field Offices.

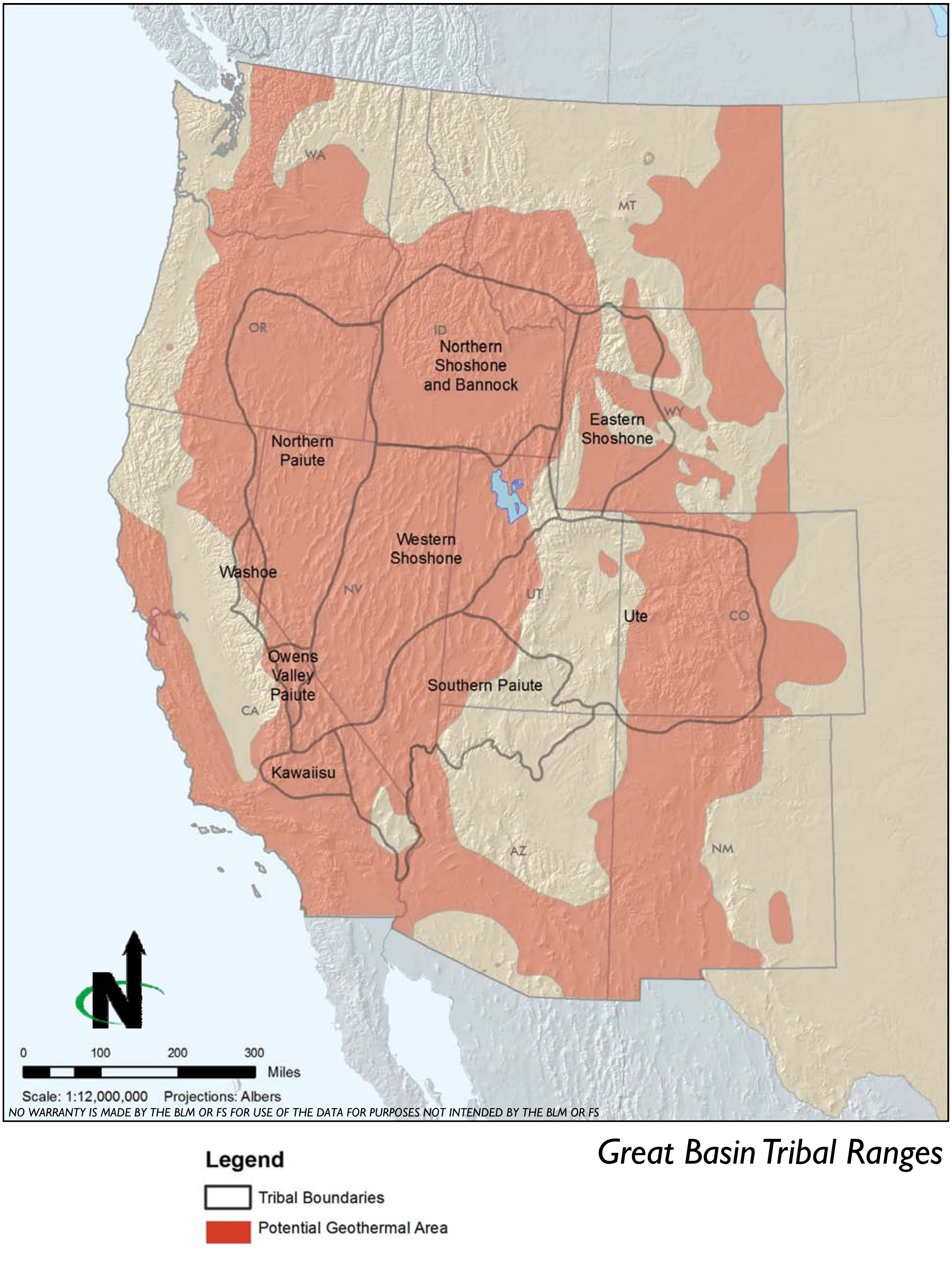
The Great Basin region exemplifies an Archaic stage for nearly all of prehistory. It is varied in landform and climate. These different environments within the region require a variety of adaptations that have resulted in diverse cultural traditions.

Based on prehistoric patterns discussed in Appendix I, expected prehistoric sites of the Great Basin region are as varied as the region. Isolated Paleoindian fluted points could occur throughout the region, particularly in Utah and the western Great Basin. Other site types found in the region include village sites with pithouses and later architecture, seasonal sites, temporary camps, burials, caches, rock art, turquoise mines, and agricultural features such as irrigation ditches. A number of areas and geographic features have been identified as particularly sensitive for one or several of these site types depending on time period and setting. These are discussed in Appendix I. A select few examples include caves, valley floors, and margins of pluvial lakes.

Spanish and Mexican exploration resulted in some early intermittent contact with Native populations of the Great Basin. This was followed by migration of peoples across and through the region but little settlement until after the mid-nineteenth century. Historic period activities include mining, ranching, farming, western expansion, railroad construction, and trail establishment. Historic-era cultural resources expected within the region include early exploration settlements and camps, mineral exploration and mining locales, mining camps, historic farms and ranches, railroad tracks and associated boom towns, and historic trail routes and associated towns.

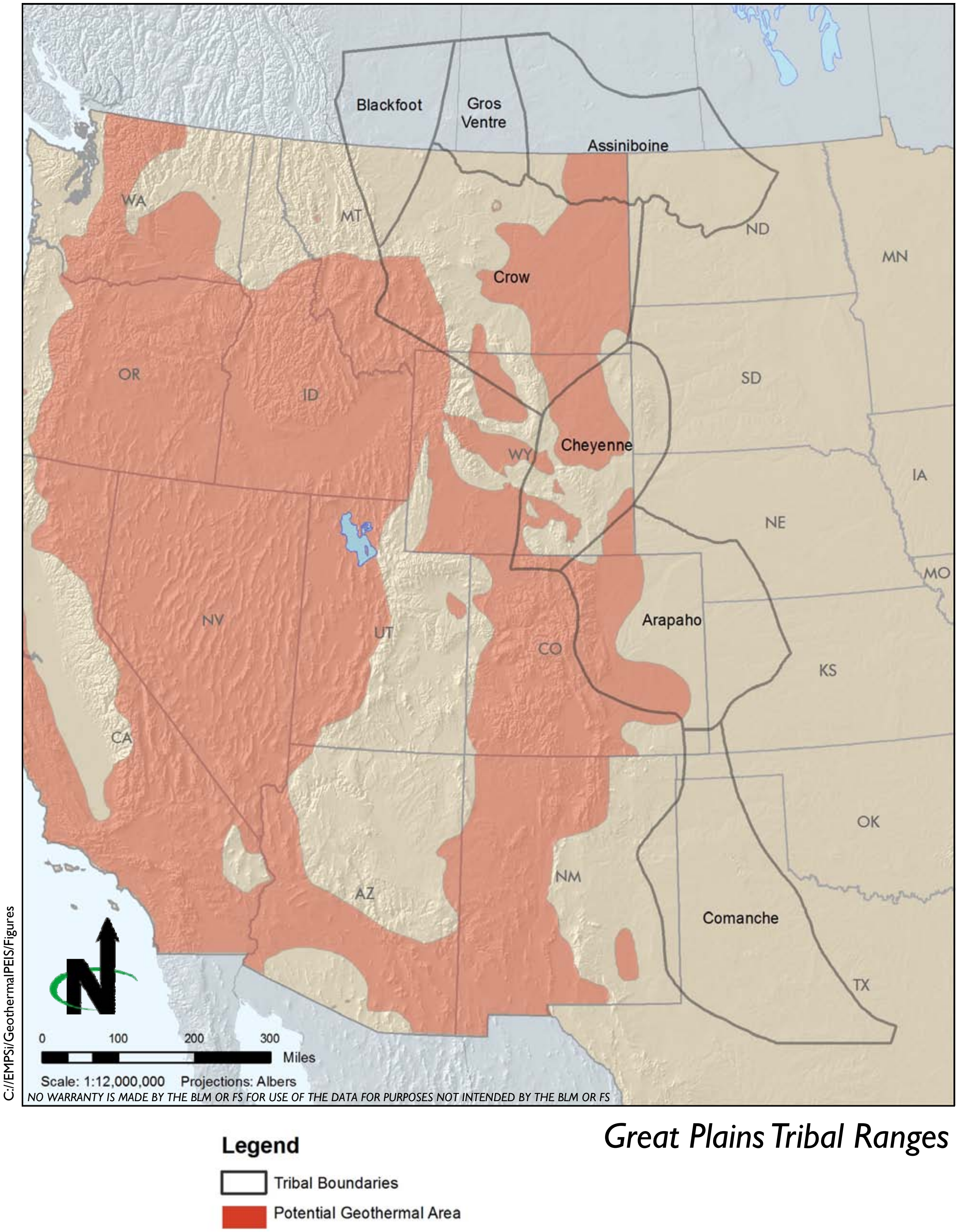
3.14.4 Great Plains

The area between the Saskatchewan River in the north, the Rio Grande in the south, the foothills of the Rocky Mountains in the west, and the upper Mississippi River valley in the east makes up the Great Plains culture region (Figure 3-18 – Great Plains Tribal Ranges). The majority of this culture region is east of the project (and planning) area; project (and planning) area states within the Great Plains culture region include eastern Montana, Wyoming, and Colorado (the easternmost portion of the project (and planning) area in New Mexico is included in the Southwest culture area). Within the project area, the Great Plains culture region includes portions of FS Regions 1 and 2 and all or portions of the western BLM Field Offices.



Great Basin Tribal Ranges

Figure 3-17



Great Plains Tribal Ranges

Figure 3-18

The cultures of the Great Plains region are quite varied, primarily due to the diverse environs it covers. Different environments require unique adaptations by the occupants. However, all cultures of the Great Plains regions have at least one trait in common: bison hunting.

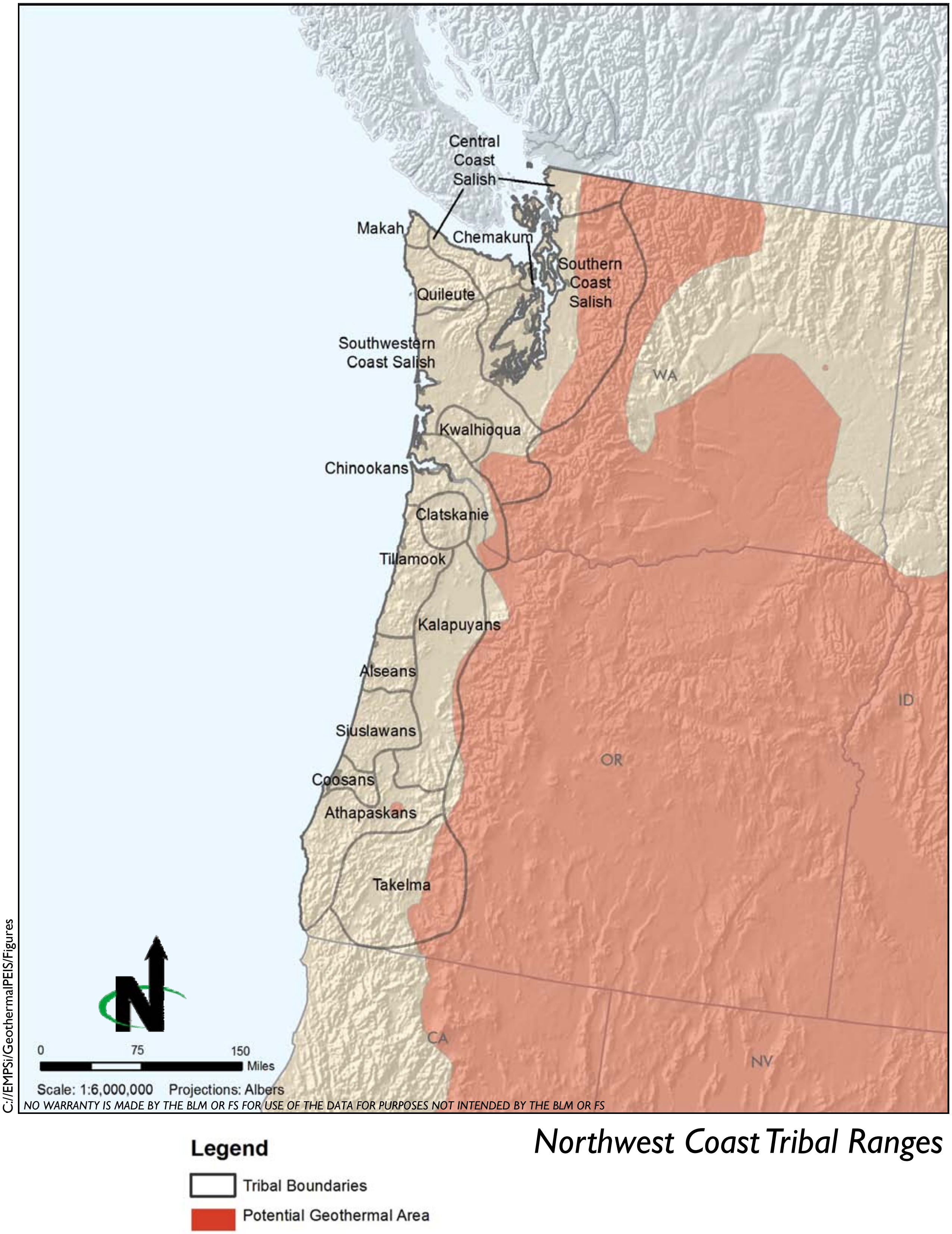
Site types expected to occur within the Great Plains culture region include surface lithic scatters, quarries, blade and biface caches, burials, large game kill sites (such as bison drives, traps, and jump sites), artificial corrals for collecting and killing large game, horticultural areas (particularly in the eastern Great Plains), occupational sites with housepits and associated storage and fire pits, stone rings, petroglyphs, pictographs, and stone cairns and lines. Additionally, horticultural features can be expected to occur in the river valleys of the region, with the exception of the northwest and western-central Great Plains. Great Plains sites can often occur in caves and rockshelters, especially in northern Wyoming and Montana, in mountainous regions, in the high plains, in arroyos, in sand dunes, on steep bluffs, along prehistoric lakeshores created by retreating glaciers, in intermontane basin interiors, in foothills, on butte tops, on barren ridges, on stream terraces, and on raised topographic features in the interior basins and plains.

The Great Plains region of the project area continued to support mobile bison hunters during the historic period, while further east, several migrations and relocations occurred, creating a tangled history of movement in those areas. One of the most significant historic occurrences in the culture region was the introduction of the horse by early Spanish explorers, which affected intertribal relations, social structures within tribes, and economies. The Spanish were followed by other Euro-Americans who developed fur and hide trading in the region. Additionally, ranching, mining, and westward expansion via railroad and trail became notable activities. Based on the discussed activities, historic-era cultural resources that can be expected within this part of the project area include exploration campsites, trading posts, ranches, mines, mining camps, early European and American settlements, and railroads and trails with their associated boom towns.

3.14.5 Northwest Coast

The Northwest Coast culture region covers areas between the crest of the Cascades and the Pacific Ocean from the Copper River delta and Yakutat Bay in Alaska, south to the Winchuck River and Cape Mendocino in California (Figure 3-19 – Northwest Coast Tribal Ranges). Within the project area, the Northwest Coast culture region includes portions of FS Regions 5, 6, and 10 and all or portions of the western BLM Field Offices.

The Northwest Coast culture region is highly varied and divided. Similar to other coastal regions, the early prehistory of the Northwest Coast has been dramatically affected by post-glacial sea level rise, resulting in inundation of the



Northwest Coast Tribal Ranges

Figure 3-19

coastline and altering coastal environments. The entirety of the Northwest Coast was ice free as of 12,000 years ago, although lands immediately adjacent to the Pacific Ocean were never glaciated. The region is unique in that its moist nature has led to excellent preservation in many saturated sites.

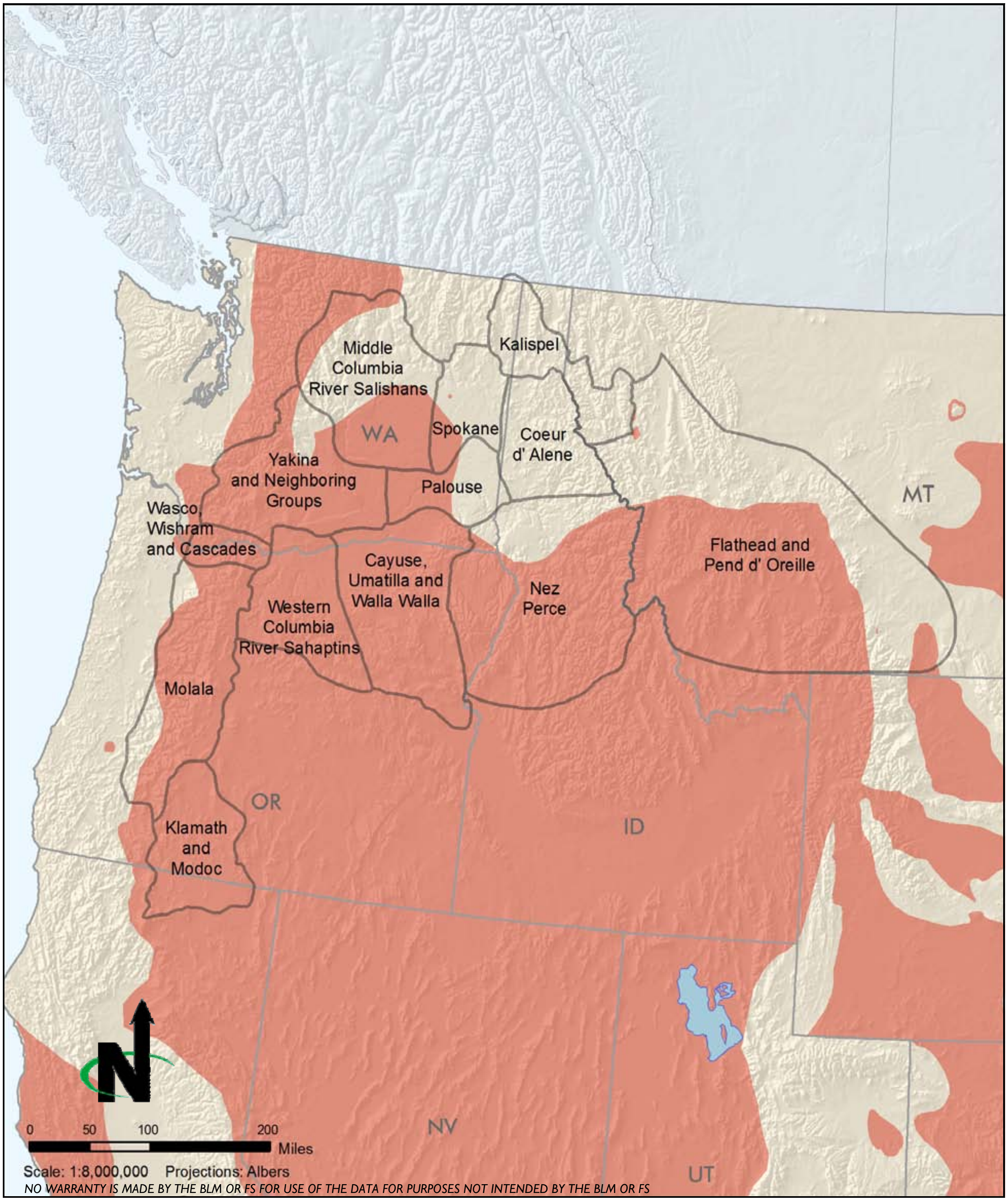
Based on the prehistoric patterns of the Northwest Coast culture region discussed in Appendix I and the environmental conditions discussed above, there is likelihood for submerged sites along coastlines and rivers. Additionally, research has suggested that many early archaeological sites may be ephemeral. Isolated Clovis fluted points could occur throughout the region as surface finds. Other site types include caches, temporary campsites, fishing sites/locales, large and dense middens, villages possibly with pithouses or preserved plank houses, cemeteries, and built fortifications. These are most likely to exist along the coast and rivers, especially the Columbia River; the eastern boundary with the Plateau culture region; and on bluff tops and other defensible locations.

Early explorers from Spain, England, and Russia brought the fur trade to the Northwest Coast culture region. Other historic industries within the region included mining of gold, silver, copper, coal, and other minerals; fishing; timber; and agriculture. A number of trails were established to facilitate exploration, trade, and migration, including the Oregon, Applegate, Cowlitz, and Lewis and Clark Trails. Additionally, railroads, along with rivers and ports, developed in the region to allow for travel and movement of goods. Site types to be expected with these activities include campsites, trading posts, trails and railroads with their associated towns, timber mills, mining camps, farms, and port cities.

3.14.6 Plateau

The Plateau culture region comprises the area drained by the Columbia and Fraser Rivers and includes portions of Oregon, Washington, Idaho, Montana, and northern California, with the exception of some areas within the Great Basin (Figure 3-20– Plateau Tribal Ranges). In general, the area covers parts of British Columbia, eastern Washington, western and northern Oregon, the Idaho panhandle, and western Montana. Within the project area, the Plateau culture region includes portions of FS Regions 1, 4, 5, and 6 and all or portions of the western BLM Field Offices.

The Plateau culture region is highly varied and has established several subregional chronologies to deal with the variety. However, researchers have identified several characteristics that are common throughout the region. These include a subsistence base of fish, game, and roots; use of complex fishing technologies; intermarriage and cooperative use of subsistence resources among groups; relatively uniform mythology, art styles, and religious practices; village and band levels of social organization; institutionalized trade; and linear settlement patterns.



Plateau Tribal Ranges

Legend

Tribal Boundaries

Potential Geothermal Area

Figure 3-20

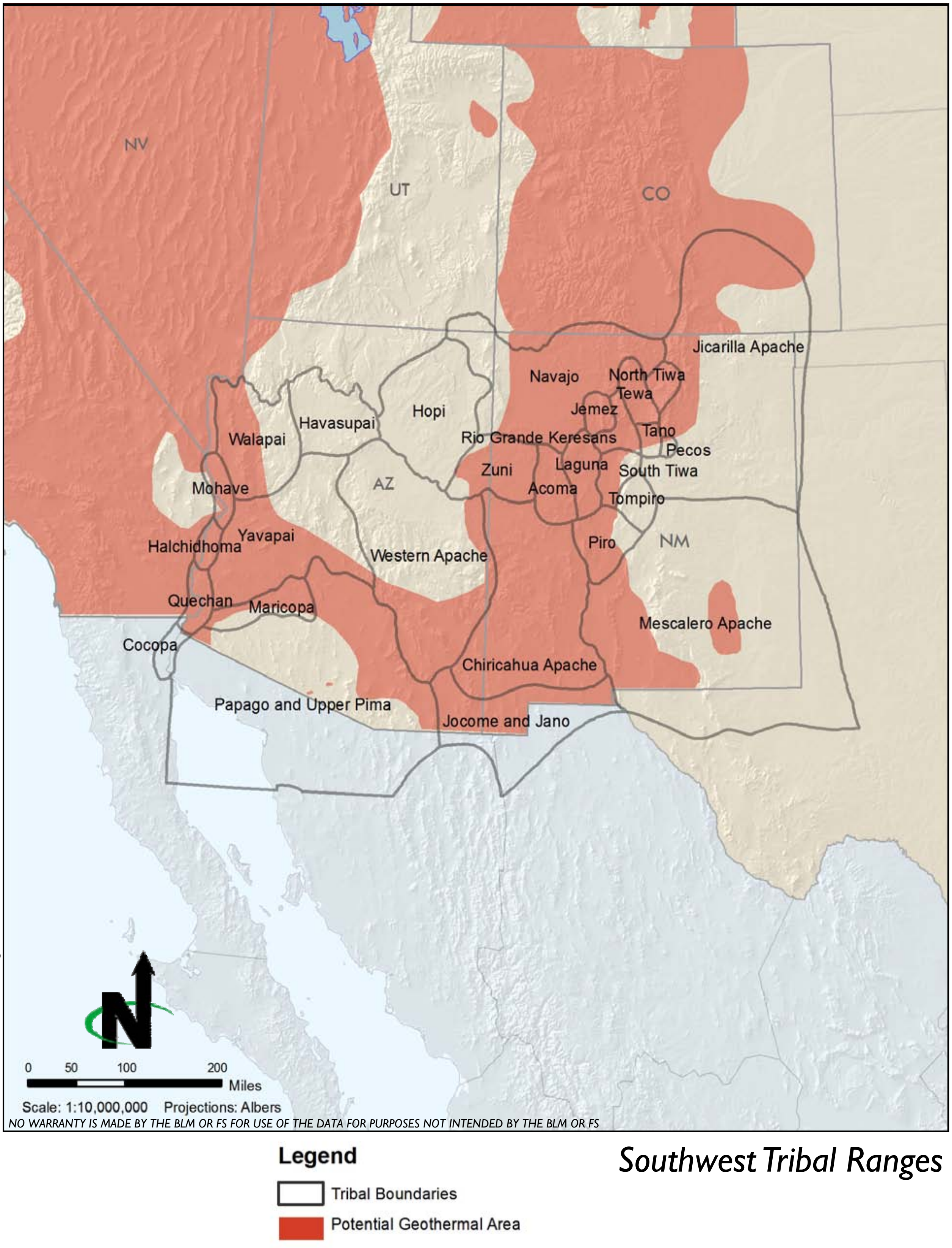
Paleoindian evidence in the Plateau culture region is represented by a single developed site and various scattered surface artifacts across the region. Early sites also indicate a disparity between the north and south, where sites in the north are often ephemeral lithic scatters and sites in the south tend to be short-term occupation sites. Often, permanent habitation sites are found near the steppe-forest margins of the lowlands. Later, village sites with large numbers of pithouses are found in the lower reaches of large rivers. Other site types expected in the region include semi-permanent villages, temporary subsistence camps, burials (sometimes with multiple internments), and bison kill sites. The likelihood of sites to occur within a specific region or topographic area depends on the time period. Sites range from high to low elevations across prehistory, often being located along main rivers.

Russian and Spanish explorers were the first to have contact with Native Americans of the Plateau culture region. Later, the Lewis and Clark expedition crossed the region and Presbyterian, Jesuit, Mormon, and Catholic missionaries settled there. Industries that developed in the region as Euro-Americans became established include the fur trade, mining, agriculture, ranching, logging, and fishing. Exploration and migration into the Plateau culture region was facilitated by the railroad and historic trails that crossed the area. Site types to be expected based on these major historic themes of the Plateau culture region include camps of early explorers, mission establishments, mines, mining camps, trading posts, farms and ranches with associated irrigation features, fisheries and canneries along major rivers, timber mills, trails (such as the Oregon and Lewis and Clark Trails), railroads, and boom towns.

3.14.7 Southwest

The Southwest culture region covers all of Arizona, the western majority of New Mexico, the southern tip of Nevada, southern Utah, extreme southern and western Texas, and parts of southwest Colorado (Figure 3.21 – Southwest Tribal Ranges). Important Ancestral Puebloan occupations in Southwestern Colorado are found outside of the tribal ranges depicted at the time of contact for the Southwest region. The region does include parts of northern Mexico, but since this part of the region is not included in the project area, it is not discussed here. USFS regions included in the Southwest region include portions of Regions 2 and 4 and all of Region 3. BLM field offices in the region include all or portions of all field offices in New Mexico and Nevada, with the exception of the Arizona Strip Office. In addition, the southwestern cultural region includes portions of field offices in southern Colorado.

This is a highly varied region culturally that is rich in cultural resources. Many of the tribes and pueblos may have more in common with neighboring cultural regions because of their shared environmental contexts. As a whole, the Southwest culture region is demanding of its inhabitants and requires extensive adaptations to its environments for survival. This is recognized in the



Southwest Tribal Ranges

Figure 3-21

development of agriculture, domestication, stone and masonry architecture, and irrigation systems, as well as mysterious abandonments in some areas. A wide array of other traditions, some having been adopted from Mesoamerican cultures, also characterizes the cultures of the region. However, because of the diversity of the environments, these adaptations vary among the area's subregions.

Evidence of the earliest human occupation in the Southwest culture region is found throughout in the form of isolated big game kill and butchering sites. More common sites expected include temporary sites with simple houses, seasonal camps, crop fields with associated irrigation features, villages with advanced architecture, pithouses, pueblos, kivas, and cliff dwellings. Sites are most expected to occur in the foothill and mountain areas; in the floors, caves, and rockshelters of valley floors formed by permanent rivers; in dry lake basins; along rivers and drainages; and on river terraces, hilltops, mesas, and other defensible locations; and in arroyo mouths. Important sites were largely abandoned in many areas prior to contact, including the four corners area north into Colorado and Utah. Later populations aggregated in the Rio Grande valley, west-central and eastern New Mexico, and eastern Arizona, making these areas particularly sensitive for later sites.

Spanish explorers entered the Southwest culture region by following the Rio Grande north from Mexico. Early cities and towns were established mostly in river valleys and associated with established Native American communities. Here, missions and military outposts were founded. New Mexico, Arizona, and Texas are particularly sensitive for these resources. Once the area was passed to Mexico and ultimately ceded to the US, development of the region continued with more military posts, stage routes, ranches, mines, and new American settlements. Other activities and site types expected to occur in the culture region include ranches and farms, trading posts, mines, mining camps, ghost towns, trails, railroads, and roads.

3.15 TRIBAL INTERESTS AND TRADITIONAL CULTURAL RESOURCES

This section is an overview of separate but related resource considerations primarily involving Native America Indian tribes and Native Alaskans. Tribal interests include economic rights such as Indian trust assets and resource uses and access guaranteed by treaty rights. Traditional cultural resources or properties include areas of cultural importance to contemporary communities, such as sacred sites or resource gathering areas. While most commonly considered in the context of Native Americans and Native Alaskans, there are traditional cultural resources associated with other ethnic or socially linked groups, such as Hispanics in the Southwest. Although Indian reservations and restricted lands are explicitly excluded from geothermal leasing under this PEIS, there are tribal and Native Alaskan interests and traditional use of public and NFS lands that could be impacted by geothermal leasing and development. Geothermal leasing and development could also impact adjacent or nearby reservations, trust lands, restricted Indian allotments, and federally tribal-dependent Indian communities.

3.15.1 Tribal Interests

The trust responsibility is the US Government's permanent legal obligation to exercise statutory and other legal authorities to protect tribal lands, assets, resources, and treaty rights, as well as a duty to carry out the mandates of federal law with respect to American Indian and Alaska Native Tribes. Federal Indian policy and trust responsibilities have developed from court decisions, congressional laws, and policies articulated by the President. Different departments, branches of government, and agencies have defined responsibilities. The Secretary of the Interior has specific trust responsibilities not delegated to any other department or agency, including holding land in trust and maintaining monetary accounts for tribes and individual tribal members.

For the BLM and FS, trust responsibilities are essentially those duties that relate to the reserved rights and privileges of federally recognized tribes as found in treaties, executive orders, laws, and court decisions that apply to public and NFS lands. Trust responsibilities for the BLM are found in DOI Secretarial Order No. 3215 (US DOI 2000), 512 Department Manual Chapter 2 (US DOI 1995), and BLM Manual H-8160-1 (BLM 1994). For FS activities, trust responsibilities are defined primarily by the authorities listed Forest Service Manual 1563.01 and by treaties that may apply to specific areas of the National Forest System. As federal land managing agencies, the BLM and FS have the responsibility to identify and consider potential impacts of plans, projects, programs, or activities on Indian lands, trust resources, and treaty rights. When planning any proposed project or action, the agencies must ensure that all anticipated effects on Indian lands, trust resources, and treaty rights are addressed in the planning, decision, and operational documents prepared for each project. Federal agencies must ensure that meaningful consultation and coordination are conducted on a government-to-government basis with federally recognized tribes.

Much of the public domain land in the lower 48 states was originally obtained by treaties made with Indian tribes. Approximately 60 tribes have treaties that contain some rights to off-reservation lands and resources. Other laws define the subsistence rights of Alaskan Natives to use natural resources on federal land (FS 1997). Treaties are negotiated contracts made pursuant to the US Constitution and take precedence over any conflicting state laws because of the Constitution's supremacy clause (Article 6, Clause 2). Treaty rights are not gifts or grants from the US, but are bargained-for concessions from sovereign governments. Other sources of defined reciprocal rights and obligations assumed by the federal government and Indian tribes include congressional and executive branch actions to acquire Indian lands, establish reservations, provide federal recognition of tribes, and remove Indian peoples to reservations or rancherias. Rights on federal lands are interpreted and applied by the federal courts. Some federal statutes, congressional acts, and executive orders do not distinguish between federally and non-federally recognized tribes and bands.

Indian tribes and Native Alaskans often view these rights and resource uses as holistically interconnected with culture, tradition, and spiritual practice. Among many groups, land, water, geologic features, landscapes, and other seemingly inanimate objects are considered sacred. Federal land policy and legal precedents, however, make distinctions between economic rights and resource uses and those that are cultural or spiritual.

Indian trust assets are legal interests in assets held in trust by the federal government for federally recognized Indian tribes or nations or for individual Indians. Assets are anything owned that has monetary value. A legal interest refers to a property interest for which a legal remedy, such as compensation or injunction, may be obtained if there is improper interference. A trust has three components, including the trustee, the beneficiary, and the trust asset. The beneficiary is also sometimes referred to as the beneficial owner of the trust asset. In the Indian trust relationship, the US is the trustee and holds title to these assets for the benefit of an Indian tribe or nation or for individuals.

These assets can be real property, physical assets, or intangible property rights. Examples include lands, minerals, water rights, gathering rights, hunting and fishing rights, rights to other natural resources and forest products, money, or claims. They need not be owned outright, but can include other types of property interest, such as a lease or a right to use something. Some treaties express a priority right for a resource; others express a proportional, or in common, right. Indian trust assets cannot be sold, leased, or otherwise alienated without federal approval.

Indian trust assets do not include things in which a tribe has no legal interest. Without a treaty or act of Congress specifying otherwise, land ownership can affect the determination of whether or not a resource is an Indian trust asset. For example, an off-reservation resource-gathering area in which a tribe has no legal property interest would generally not be considered an Indian trust asset. In this case, if religious or cultural resources could be affected by the federal action, these interests would be addressed as part of the cultural resources or social impact assessment because of the lack of legal property interest. The same resource on a reservation, trust, or ceded land may be an Indian trust asset, as determined on a case-by-case basis.

The DOI's Departmental Manual Part 303, Indian Trust Assets, defines general DOI policy and principles for managing Indian trust assets. Department of the Interior agencies are required to protect and preserve Indian trust assets; ensure their use promotes the interests of the beneficial owner; enforce leases; promote tribal control; manage and distribute income; maintain good records; and protect treaty-based fishing, hunting, gathering, and similar rights of access and resource use on traditional tribal lands.

Several tribes are also interested in recovering ownership of lands that were part of their original land base and, therefore, would be concerned about committing lands to other uses. The federal government has the authority to convey land to federally recognized tribes under different authorities. The FS exchanges land, BLM transfers land, and Congress may legislatively restore or create tribal land out of federal land. Land has been conveyed in recent years through these means.

Some tribes that were parties to unratified treaties did not surrender any land or resources to the US. Although these cases were settled, some individuals and tribes did not accept the land settlement money. The DOI, through the Bureau of Indian Affairs, holds accounts for those who have not extinguished their aboriginal claims to land and who continue to reserve the right to pursue further legal action.

Other tribal interests include general concerns about ecosystem management, maintaining healthy lands and water, and restoring the natural resource base. Tribal and Native Alaskan communities and regional entities often request that their local knowledge be included in resource management decisions.

3.15.2 Traditional Cultural Resources

Traditional cultural resources or properties are places associated with the cultural practices or beliefs of a living community. They can be considered a subset of the broader category of cultural resources, which are discussed in Section 3.14. Traditional cultural properties are rooted in the community's history and are important in maintaining cultural identity. Examples of traditional cultural properties include natural landscape features, ceremonial and worship places, plant gathering locations, traditional hunting and fishing locations, ancestral archaeological sites, artisan material locations, rock art and communal resources such as community-maintained irrigation systems. The boundaries of these resources and impact areas are often difficult to assess. Resources tied to particular locations and that meet the criteria for eligibility can be listed on the National Register of Historic Places. Some traditional cultural resources have values that do not have a direct property referent and may not manifest themselves by distinguishable physical remains, but still are subject to consideration in planning. It is the continuity of their significance and importance to the maintenance of contemporary traditions that is important.

While many traditional cultural resources are well known, some locations or resources may be privileged information that is restricted to specific practitioners or clans. For tribes, maintaining confidentiality and customs regarding traditional knowledge may take precedence over identifying and evaluating these resources, unless they are in imminent danger of damage or destruction. In some cases, the connections of contemporary communities with a particular location or an ancestral site may have been lost, but are rediscovered or recognized during the planning process. A person with traditional knowledge may associate a place or site with a tradition, practice, oral history, ancestral use, or belief important to the community's cultural life. For identification of traditional cultural resources, field visits are usually required. Systematic field survey could be needed to locate resources, such as ancestral archaeological sites. Ethnographic studies could be necessary to ensure issue identification. Multiple tribes may have interests potentially affected in a particular lease area. Agencies must be flexible in making a good-faith effort to consult with tribes when their actions could affect these resources. Consultation must be conducted in a manner that is sensitive to different world views, time frames, communication modes, and information confidentiality.

3.15.3 Tribal Interests and Traditional Cultural Resources

Project Area

Tribal Interests and traditional cultural resources are identified primarily through consultations with federally recognized Indian tribes on a government-to-government basis (Executive Order 13084 and Executive Memorandum of April 29, 1994, on Government-to-government Relations with Native American Tribal Governments). In the case of non-federally recognized tribes and other potentially affected communities, direct consultations are also necessary to identify traditional cultural resources.

Typically the tribal government is the primary point of contact for identifying Indian trust and treaty rights, but the US Bureau of Indian Affairs and the Interior Office of the Special Trustee are also often consulted. In the lower 48 states, there are 46.2 million acres of Indian trust land and 8.9 million acres of individual trust allotments (FS 1997). There is no comprehensive list of all Indian trust assets for tribes and individual Indians. If needed, further information on the nature of the trust asset is determined by examining government documents, such as treaties, court decisions, water rights adjudication proceedings, and reservation-establishing proclamations. Since trust and treaty rights are often subject to interpretation and are often contested, agency legal counsel is usually consulted.

For the purposes of this PEIS, in September 2007, an initial contact letter was sent via certified US Mail by the Deputy Director of the BLM and Deputy Chief of the FS to over 400 tribes and Alaskan Native groups in the project area. The letter described the PEIS process and pending lease locations and invited recipients to consult on the project. Previously, in June 2007, these groups were also sent a newsletter announcing the project. To date, responses have been received from seven tribal representatives. Four respondents requested that their groups be consulted on the project if lease areas fall within their areas of interest. Two respondents requested consultation and to participate in the PEIS process. One respondent noted that no lease applications were in their area of interest. Additional contact efforts are planned, and agency consultation will be conducted with those tribes and Native Alaskan groups who have requested inclusion. Consultation and coordination efforts are described further in Chapter 6.

Planning Area

In the planning area, there is extensive geographic, environmental, historic, economic, social, ethnic, and religious diversity that is reflected in the tribal interests and traditional cultural resources that may be valued by Native American, Native Alaskans, and other potentially affected communities. There is no comprehensive way to define all of the resources on this broad scale, especially where confidentiality is often required. There is also considerable overlap between what an outsider or another group might define as economic interests and natural resource issues, and ones that have religious and cultural meaning to a group. Throughout the western US, the BLM and FS have established programs and relationships with tribes that provide the means to further engage tribes on their interests, values, concerns, and priorities on a more-local level and project-specific basis. Continued consultations and ethnographic studies would be necessary to identify issues specific to locations considered for geothermal leasing in the planning area. Some common categories of these interests and resources are presented here.

The planning area includes Indian trust or restricted lands in which the title is held by the US in trust for an Indian or an Indian tribe, or lands in which the title is held by Indians or an Indian tribe but is subject to restriction by the US against transfer. These lands can be on or off reservations. The BLM is prohibited from issuing leases on these properties, but trust assets need to be identified. There may be conflicts with agencies about existing trust assets, tribal treaty rights, or ownership claims. Tribes may have interests in converting public and FS land to trust land or in reestablishing portions of their ancestral land base.

There are tribal interests and traditional cultural resources associated with water rights and the uses of water sources, such as rivers, lakes, and springs.

Although Indian-reserved water rights are not expressed in treaties, they are inherent or implied rights. The reserved water right as applied to Indians is derived from Winters v. US 1908. This Supreme Court case held that, "sufficient water was implicitly reserved to fulfill the purposes for which the reservation was established." The Winters Doctrine provides that tribes have senior water rights. Recent court cases have found that Indian reservations have priority water rights on federal lands, including public and NFS lands. Water rights and priority claims for reservation and off-reservation uses are likely to occur in the planning area. Additionally, these rights and claims often are in the same geographic area where tribes could have concerns about enhancing flows for fish, maintaining plant and wildlife riparian habitat, and preserving cultural locations' use and setting (FS 1997). Among many tribes, all water and water sources are associated with power and essential life forces. Water sources are considered sacred, and hot springs are especially important. Springs are places where prayers are said, ceremonies are held, and offerings are made. The hot mineral water and mud from hot springs are often used for healing (Bengston 2003).

Resource-gathering areas are a broad category that can include trust assets; treaty and subsistence rights and resources; and culturally significant plants, animals, fish, and minerals. Plant resources can include foods that were established as part of a traditional seasonal round. Examples include traditions of gathering acorns in California, pine nuts in Nevada, camas roots in the Pacific Northwest, berries in the Plateau region, mesquite pods in the Southwest, and a variety of seed plants west-wide. Other examples of plant resources include fibers used for basketry and weaving in the eastern Sierra, and wood for building, carving, and fuels. Many plants are gathered for medicinal and religious use. Plant gathering is often a communal activity with cultural and religious significance. Loss of access to these plants or gathering locations, or losing the ability to maintain their habitats, can affect religious and ceremonial uses.

Hunting and fishing rights are often guaranteed by treaties, and many traditionally used locations and habitats are prized. Wildlife and fish are also important in the cosmology of many Native American groups and in exercising traditional lifeways. In Alaska, for example, some hunting and butchering is often a community-based traditional activity as well as a subsistence right. In the Pacific Northwest, salmon continues to be a large part of most Columbia River tribes' culture and is connected to sustaining life and culture. For some groups, animal species are considered ancestors or spiritual beings, which are treated with respect and taken for food or fur only after the hunter establishes a relationship through rituals and offerings. Traditionally used fishing and hunting locations can be important, as can be the lands and waters that support wildlife and fish habitat. Other interests include tribal grazing rights that could be included in treaties or agreements, as well as gathering locations for rocks, minerals, and soils. For example, in the Southwest and elsewhere, clays for pottery and minerals for glazes and pigments are gathered from public and NFS lands.

Most American Indian tribes and individual tribal members conceive of spirituality, or sacred sites and daily activities, as interconnected. The spiritual and natural worlds are not separate from everyday life (FS 1997). Many of the resource uses and use areas described above also have a spiritual or sacred dimension. Sacred sites can also include places that are an expression of belief systems in the land or nature. For some sacred areas, there may be no observable cultural function to an outsider or even to tribal members who have not been entrusted with the information. Indian people determine what is of spiritual importance to them. Locations such as landscape features, mountain tops, trails, water courses, springs, caves, offering areas, shrines, and rock art sites often figure in these groups' oral traditions concerning their origins, mythology, and the nature of the world. There are frequently active or ancestral ceremonial locations that are treasured. Archaeological sites, burials, and historic sites are often seen as important ties to ancestors and traditions that are not to be disturbed (Bengston 2003).

Based on comments on the Draft PEIS, in addition to the physical components of the environment described above, the quality of the natural environment, such as clean water and a pure, untainted airshed are basic Tribal cultural values.

3.15.4 Climate Change

The status of the local ecosystem, including but not limited to vegetation composition and any wildlife, is integral to many native cultures. Potential changes in local ecosystems associated with effects of climate change may alter the availability of plants, wildlife, or other natural resources for traditional uses.

3.16 NATIONAL SCENIC AND HISTORIC TRAILS

3.16.1 Background

The National Trails System Act of 1968 (16 USC 1241-51) established the framework for the National Trails System. The purpose of this Act is to accommodate the outdoor recreation needs of an increasing population, while preserving the environment, history, and natural aesthetics of open areas (BLM 2006d). National Scenic Trails and National Historic Trails are congressional designations given to protected areas in the US that contain trails and surrounding areas of particular natural beauty and historic significance. National trails are officially established under the authorities of the National Trails System Act (16 USC 1241-51). The National Trails System is made up of National Scenic Trails, National Historic Trails, and National Recreation Trails.

National Scenic Trails are 100 miles or longer, continuous, primarily nonmotorized routes of outstanding recreation opportunity. National Historic Trails commemorate historic and prehistoric routes of travel that are of significance to the entire nation. National Historic Trails have as their purpose the identification and protection of the historic route and its historic remnants and artifacts for public use and enjoyment (US DOI, National Park Service 2006a). They must meet three criteria listed in Section 5(b)(11) of the National Trails System Act:

- They must follow actual documented route of historic use;
- They must be of national significance; and
- They must possess significant potential for public recreation and/or interpretation.

National Scenic Trails and National Historic Trails may only be authorized by Congress. National Recreation Trails, also authorized in the National Trails System Act, are existing regional and local trails recognized by either the Secretary of Agriculture or the Secretary of the Interior upon application.

Administration of each trail is officially assigned to or shared among the US DOI, National Park Service, BLM, and/or the FS. Subject to available funding, the administering agencies exercise trail-wide responsibilities under the Act for that specific trail. Such responsibilities include coordination among and between agencies and partner organizations in planning, marking, certifying, preserving and protecting resources, interpreting, establishing cooperative / interagency agreements, and offering financial assistance to other cooperating government agencies, landowners, interest groups, and individuals.

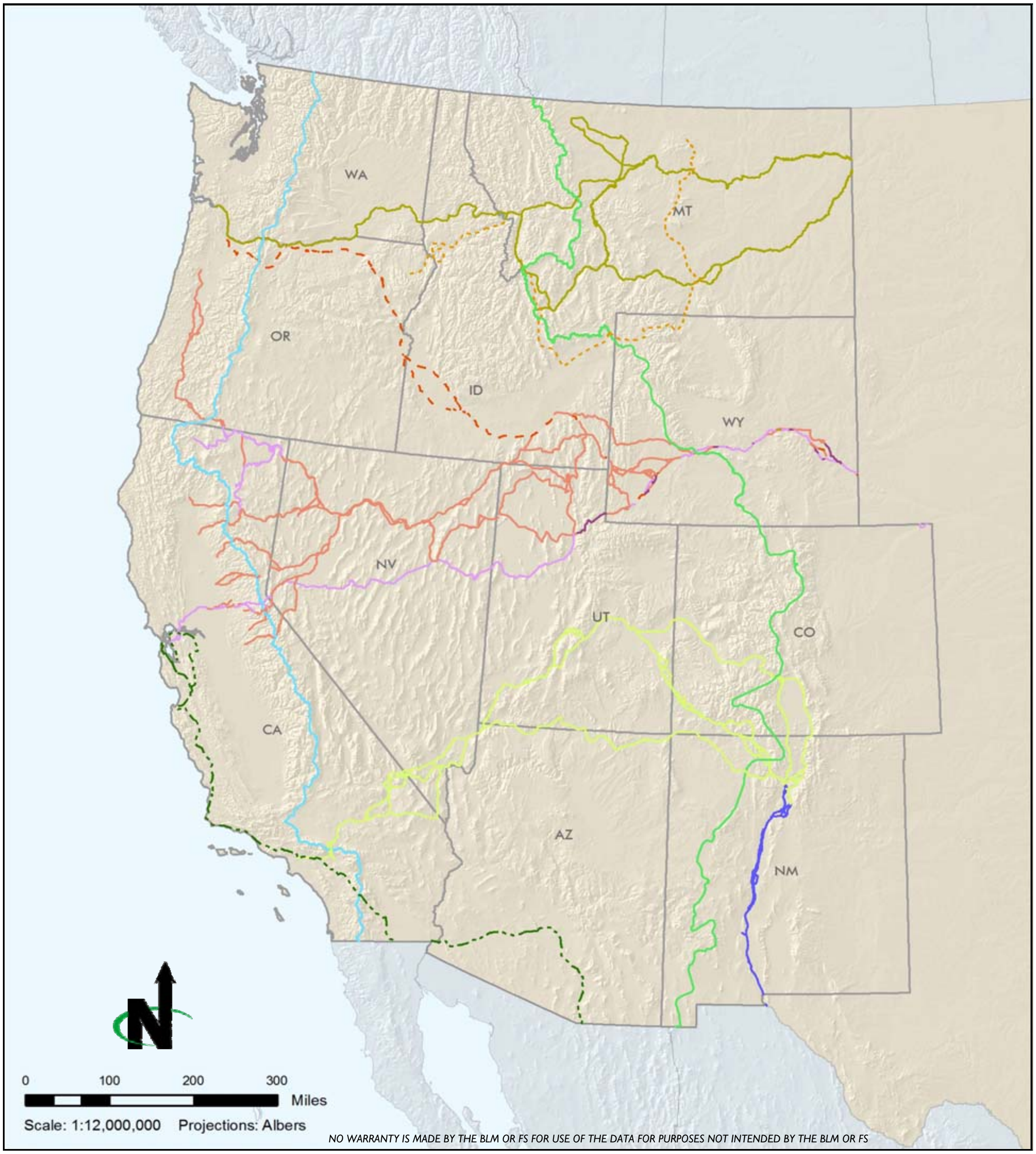
National trails cross numerous jurisdictions, with various segments managed by a variety of landowners or agencies. On-site management responsibilities often include inventorying of resources and mapping, planning and developing trail segments or sites, ensuring compliance, making provisions of appropriate public access, offering site interpretation, maintaining trails, marking trails, preserving or protecting resources, protecting viewsheds, and managing visitor use.

In the project area, the BLM manages public lands in 10 western states that include 2 National Scenic Trails and 11 National Historic Trails (Table 3-28). In the project area, the FS manages NFS lands that include portions of one National Historic Trail and two National Scenic Trails (Table 3-28). Figure 3-22 shows the distribution of National Scenic and Historic Trails throughout the project area, identifying each trail by name. There are approximately 15,280 miles of National Historic Trails and National Scenic Trails within the project area. Within the planning area, National Scenic Trails and National Historic Trails traverse approximately 3,005 miles of public land and approximately 3,168 miles of NFS land.

Table 3-28
Project Area National Trails

Trail Name	Type	Project Area (approx. miles)	Planning Area (approx. miles)	Public (BLM) or NFS (FS) Lands Affected	Administering Agency (if BLM or FS)
California	National Historic Trail	3,296	1,844	Public lands	other
Continental Divide	National Scenic Trail	1,775	1,453	Public lands; NFS lands	FS
El Camino Real de Tierra Adentro	National Historic Trail	645	249	Public lands	BLM (with US DOI, National Park Service)
Iditarod	National Historic Trail	78	1.5	Public lands	BLM
Juan Bautista de Anza	National Historic Trail	1,039	218	Public lands	other
Lewis and Clark	National Historic Trail	1,321	420	Public lands	other
Mormon Pioneer	National Historic Trail	57	99	Public lands	other
Nez Perce	National Historic Trail	539	421	Public lands; NFS lands	FS
Old Spanish	National Historic Trail	2,615	1566	Public lands	BLM (with US DOI, National Park Service)
Oregon	National Historic Trail	1,133	436	Public lands	other
Pacific Crest	National Scenic Trail	1,598	1,394	Public lands; NFS lands	other
Pony Express	National Historic Trail	1,263	617	Public lands	other
Santa Fe	National Historic Trail	unknown	unknown	Public lands	other

Source: BLM 2006d; US DOI, National Park Service 2006a, 2006b.



C://EMPSi/GeothermalPEIS/Figures

11 National Scenic and Historic Trails are located in the project area. Alaska has one trail in the planning area.

Legend

National Scenic and Historic Trails

- California
- Continental Divide
- El Camino Real de Tierra Adentro
- Juan Bautista de Anza
- Lewis and Clark
- Mormon Pioneer
- Nez Perce
- Old Spanish
- Oregon
- Pacific Crest
- Pony Express

National Scenic and Historic Trails in the 11 Western States

Figure 3-22

3.16.2 National Historic Trails

California Trail

The trail was used by over 250,000 farmers and gold seekers during the 1840s and 1850s. The route starts along the Missouri River and then converges on the Great Platte River Road, overlaps with the Oregon Trail, and continues through the Rocky Mountains. After crossing the Rockies, many routes were used to get to and cross the Sierra Nevada. The total system of trails that make up the California Trail is approximately 5,664 miles (US DOI, National Park Service 2007c). Within the project area, there are approximately 3,296 miles of the California Trail. The California Trail crosses approximately 1,039 miles of public land and approximately 261 miles of NFS land within the planning area.

El Camino Real de Tierra Adentro

This trail dates back to the Spanish Colonial era of the sixteenth to nineteenth centuries when it was the primary route between Mexico City, the capital of New Spain, and other Spanish provincial capitals (National Park Service, 2006c). From Mexico, the trail crosses briefly into west Texas and then north through New Mexico to Santa Fe. The trail was used for trade and interaction among Europeans, Spaniards, Mexicans, and Native Americans and affected settlement and development within the southwest (National Park Service, 2006c). Within the project area, there are approximately 645 miles of the El Camino Real de Tierra Adentro Trail. The trail crosses approximately 66 miles of public land and approximately 8 miles of NFS land within the planning area.

Iditarod Trail

The Iditarod Trail, located in Alaska, was a path originally used by Native American hunters and Russian explorers. In the twentieth century, gold seekers used the trail to reach the mines, and the trail was improved. Several towns, such as Seward, Iditarod, and Nome, grew up around the mining districts, where miners would buy supplies from local stores and markets and would stay overnight in tents before going to the mines. The trail begins in two places, Seward and Nome, and the two legs eventually met at the Iditarod Mining District. It was officially surveyed by the US Army's Alaska Road Commission in 1908 and was heavily used until 1924, when the airplane became common for travel. The trail was not well used again until the 1960s, when dog sledding became an interest; the first dog sled race took place in 1967. The total length of the Iditarod trail in the project area is approximately 938 miles. Within the planning area, there are approximately 1.5 miles of the Iditarod Trail. Overall trail administration has been delegated by the US DOI to the BLM, and the trail includes approximately 85 miles of BLM lands and an additional 52 miles of State and Native Lands that the BLM is currently administering (Krantz 2008). The route includes no NFS land.

Nez Perce (Nee Me Poo)

This trail extends from Wallowa Lake in Oregon to Bear Paw Mountain in Montana. It is named for the Nez Perce Tribe of Native Americans who were forced to leave their lands and move to a reservation. During the travels, fighting occurred between the Nez Perce and white settlers. The US Army was called, and the Nez Perce attempted to flee to Canada. Approximately 750 Nez Perce men, women, and children traveled over 1,170 miles through the mountains on a journey that lasted from June to October of 1877 (FS 2007h). From Wallowa Lake, the trail extends east through the Snake River at Dug Bar, entering Idaho at Lewiston, and then entering north-central Idaho at Bannock Pass. The trail then travels back to the east into Montana at Targhee Pass to cross the Continental Divide. It bisects Yellowstone National Park in Wyoming, and then follows the Clark Fork River out of Wyoming into Montana. The trail then heads north into Bearpaw Mountains and ends forty miles from the Canadian border (FS 2007h). Approximately 539 miles of the Nez Perce Trail traverses the project area. Within the planning area, this trail crosses approximately 74 miles of public land and approximately 183 miles of NFS land.

Juan Bautista de Anza

This trail was used by a party of 300 Spanish colonists, led by Colonel San Juan Bautista, from Mexico to California in 1775. The party intended to establish a mission and presidio (military post) in Alta, California, to secure the area from the Russians and British, who also had claimed the land. It was the first overland trail that connected New Spain with Alta, California (US DOI, National Park Service 2007b). The party contained 30 families, a dozen soldiers, cattle, mules, and horses. The trail is over 1,200 miles long, and it took the party three months to follow the trail through the southwest desert before reaching the California coast. It took another three months to travel from the southern coast up the northern coast to present-day San Francisco (FS 2007i). There are approximately 1,039 miles of the Juan Bautista de Anza Trail within the project area. Within the planning area, the trail crosses approximately 84 miles of public land and 11 miles of NFS land.

Lewis and Clark

This trail runs along the early explorations of Meriwether Lewis and William Clark on behalf of the US. The trail follows the Missouri River upstream, eventually reaching the Pacific Ocean at the mouth of the Columbia River. The route goes through Idaho and western Montana for a total of approximately 1,321 miles within the project area. There are approximately 28 miles on public land and 49 miles on NFS land within the planning area.

Mormon Pioneer Trail

One of the major forces of settlement in the West was Mormon emigration. Sixteen hundred Mormons left Illinois in February 1846, crossing into Iowa to escape religious persecution (Billington 1963). Their leader, Brigham Young, opted not to follow the Oregon Trail but instead forged a new route just north of the Platte River. This was because the route was better suited to wagon travel and he wished to avoid other travelers from Missouri who frequented the Oregon Trail (Billington 1963). The Mormons crossed Mississippi and established temporary headquarters there, then went on to Missouri, and through the Great Plains, where they spent an icy winter and lost 600 people from their party (Billington 1963). They reached the Valley of the Great Salt Lake, where they settled, in June 1847. There are approximately 57 miles of the Mormon Pioneer Trail within the project area. Within the planning area, the trail crosses public land for approximately 8 miles. It does not cross any NFS lands within the planning area.

Old Spanish

Before there was the Old Spanish Trail, an overland southern route to California from New Mexico did not exist. This trail was first established by a Mexican trader, Antonio Armijo, in 1829. He traveled from Santa Fe, New Mexico, to Los Angeles, California, on a commercial caravan, carrying Mexican woolen goods and planning to bring horses back from California (US DOI, National Park Service 2007c). Portions of the trail had been used as a Native American footpath, an early trade route, and a horse and mule trail. The trail runs through present-day Colorado, Utah, Arizona, Nevada, and California (Cultures and Histories of the American Southwest 2007). There are approximately 2,615 miles of the Old Spanish Trail within the project area. Within the planning area, it crosses public land for approximately 750 miles and NFS land for 275 miles.

Oregon Trail

Fur trappers and traders used this trail to access the Northwest Coast. The Oregon Trail was used by settlers traveling to the Plateau Region or to pass through en route to more westerly points. The trail began as an unconnected series of trails used by Native Americans. Fur traders expanded the route to bring pelts to trading posts in the early 1800s. The route extends roughly 2,000 miles west, from Missouri toward the Rocky Mountains to the Willamette Valley; a trail to California digressed from the route in Idaho (BLM 2008k). Several groups followed the route over time, including large populations of settlers, moving from the eastern portion of the US to settle the west between 1800 and the 1880s (BLM 2008k).

Missionaries used the trail during the 1830s, traveling along the Platte and Snake Rivers to settle churches in the Northwest. Mormons, headed toward the Great Salt Lake in Utah, used the trail beginning in 1847, and the discovery of gold in California caused many gold miners to use the trail in 1849. It is estimated that 4,000 emigrants followed the trail west in 1847 (Schwantes 1989), many in small caravans of wagons. Military posts and spur roads were established off the Oregon Trail. The trail was the major connection between the east and western portions of the US. It was used as a cattle driving trail eastward for a brief time as well. The construction of the Central Pacific Railroad, connecting California to the rest of the continent in 1869, decreased use of the Oregon Trail. By the early twentieth century, railroad lines paralleled the trail, and it was no longer used as a major transportation corridor (BLM 2008k and Schwantes 1989). There are approximately 1,133 miles of the Oregon Trail within the project area. Within the planning area, it crosses approximately 176 miles of public land and approximately 46 miles of NFS land.

Pony Express National Historic Trail

This began in 1860 as a mail route connecting the eastern US with California. It was privately financed and was used only for 18 months before the telegraph system was constructed and replaced the Pony Express. Riders on horseback transported mail from Missouri to California in ten days, traveling over 1,800 miles. The transcontinental railroad later followed much of this route (US DOI, National Park Service 2007b). Within the project area, there are approximately 1,263 miles of the Pong Express Trail. Within the planning area, it crosses approximately 448 miles of public land and approximately 187 miles of NFS land.

Santa Fe Trail (Kansas to Santa Fe)

This trail was used for trade and commerce between 1821 and 1880 (US DOI, National Park Service 2008). It extended from Missouri to New Mexico, branching into the Mountain Route and the Cimarron Route (Santa Fe 2008). Except for a short hiatus during the Mexican-American War between 1846 and 1848, the trail provided international passage of goods and travelers. Both during and after the war, the Santa Fe Trail was used heavily for freighting of military supplies to forts in the southwest. Once the railroad extended into the southwest territory, the trail was no longer used. The 1,203 miles of trail are managed by the NPS (US DOI, National Park Service 2006b) and do not cross public or NFS lands.

3.16.3 National Scenic Trails

Continental Divide

Congress designated this 3,100-mile scenic trail in 1978, extending from Canada to Mexico, crossing Montana, Idaho, Wyoming, Colorado, and New Mexico (Continental Trail Alliance 2005). The trail runs along the Continental Divide of the North America. There are approximately 1,775 miles of the trail within the project area. It crosses approximately 191 miles of public land and approximately 1,099 miles of NFS land within the planning area.

Pacific Crest

This trail runs from the Cascade and Sierra Nevada Mountains, from Canada to Mexico. It was inspired by the 1930s idea of a long-distance mountain trail and passes through 25 National Forests and 7 National Parks. It was completed in Oregon and Washington in 1987 (FS 2007i). Within the project area, it runs for approximately 1,598 miles. It traverses approximately 141 miles of public land and 1,049 miles of NFS land within the planning area.

3.17 VISUAL RESOURCES

This section describes visual resources in the project area and planning area, as well as regulations associated with visual resources.

General Visual Setting

The project area encompasses a wide variety of landscape types that can be categorized into ecological regions (or ecoregions). Attributes used to characterize an ecoregion include geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology, all of which influence visual resources (US EPA 2007d). Visual resources are generally homogenous within an ecoregion. The coverage of an ecoregion within any one state varies greatly. A description and figure of the project and planning area ecoregions is provided in Section 3.9, Vegetation, and Appendix G.

Although the population is not evenly distributed across the project area or planning area, human influences have altered much of the visual landscape, especially with respect to land use and land cover. In some places, intensive human activities, such as mineral extraction and energy development, have significantly altered the natural visual landscape. Large, fast-growing cities also contain heavily altered landscapes, with urban sprawl spreading into what were recently relatively undisturbed landscapes.

3.17.1 US Department of the Interior, Bureau of Land Management Visual Resources

In accordance with FLPMA, the BLM is entrusted with the multiple-use management of natural resources on public land, which contain many outstanding qualities, including scenic landscapes. In managing public lands for multiple uses, the BLM is constrained by the legal mandate to "protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archaeological values…and provide for…human occupancy and use" (BLM 2008j).

The BLM's Visual Resource Management (VRM) system guides visual resources management on public lands (BLM 2007j). Visual resources are defined as the visible physical features on a landscape (e.g., land, water, vegetation, animals, structures, and other features). There are three stages of the VRM system: inventory (visual resource inventory), assigning VRM Management Classes, and analysis (visual resource contrast rating).

The visual resource inventory process provides BLM managers with a means for determining visual values. The process involves a scenic quality evaluation, sensitivity level analysis, and a delineation of distance zones. The process is described in detail in BLM Handbook H-8410-1, Visual Resource Inventory. Based on these three factors, BLM-administered lands are placed into one of four visual resource inventory classes. These inventory classes represent the relative value of the visual resources. Classes I and II being the most valued, Class III representing a moderate value, and Class IV being of least value. The inventory classes provide the basis for considering visual values in the resource management planning (RMP) process. Visual Resource Management classes are established through the RMP process for all BLM-administered lands. During the RMP process, the class boundaries are adjusted as necessary to reflect the resource allocation decisions made in RMP's.

Visual management objectives are established for each class. The VRM class objectives for visual resources on public lands are:

- VRM Class I Objective: To preserve the existing character of the landscape. The level of change to the characteristic landscape should be very low and must not attract attention.
- VRM Class II Objective: To retain the existing character of the landscape. The level of change to the characteristic landscape should be low.
- VRM Class III Objective: To partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate.
- VRM Class IV Objective: To provide for management activities which require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high.

Where a project is proposed and there are no RMP-approved VRM objectives, interim visual management classes are established (BLM 2007k). Interim classes are developed using the guidelines in Section I to V of BLM Handbook H-8410-1, Visual Resource Inventory, and must conform with the land-use allocations set forth in the RMP which covers the project area. The establishment of interim VRM classes will not require a RMP amendment, unless the project that is driving the evaluation requires one. The analysis stage (visual resource contrast rating) involves determining whether the potential visual impacts from proposed surface-disturbing activities or developments will meet the management objectives established for the area, or whether design adjustments will be required (BLM 2007j). A visual contrast rating process is used for this analysis, which involves comparing the project features with the major features in the existing landscape using the basic design elements of form, line, color, and texture. The analysis is also influenced by the number of and proximity of receptors sensitive to visual resources. This process is described in BLM Handbook H-8431-1, Visual Resource Contrast Rating. The analysis can then be used as a guide for resolving visual impacts. Once every attempt is made to reduce visual impacts, BLM managers can decide whether to accept or deny project proposals; attaching additional mitigation stipulations to bring the proposal into compliance; or change the VRM management classification through an RMP amendment.

General Description of Visual Resources by VRM Class

Visual Resource Management Class I

VRM Class I is assigned to those areas where a management decision has been made previously to maintain a natural landscape (BLM 2007k). This includes areas such as national wilderness areas, the wild section of rivers in the National Wild and Scenic Rivers System, and other congressionally and administratively designated areas where decisions have been made to preserve a natural landscape. Class I provides for natural ecological changes; however, it does not preclude very limited management activity. VRM Class I areas are typically more remote and unaltered by human disturbances than VRM Class II, III, and IV areas.

Areas with special designations (such as rivers in the National Wild and Scenic Rivers System, wilderness areas, wilderness study areas, scenic roadways, and National Park System lands) have valuable scenic resources. These areas are typically minimally developed and have greater restrictions on the types of allowable activities in order to, for example, preserve the area's visual resources. Section 3.2, Land Use, Recreation, and Special Designations describes these areas and their management.

Visual Resource Management Classes II, III, and IV

VRM Classes II, III, and IV are assigned based on a combination of scenic quality, sensitivity level, and distance zones (BLM 2007k). In VRM Class II areas, management activities may be seen but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape. In VRM Class III areas, management activities may attract attention but should not dominate the view of the casual observer. Changes should also repeat the basic elements found in the predominant natural features of the characteristic landscape. In VRM Class IV areas, management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements. Typically, VRM Class IV areas are noticeably modified by surface disturbances (such as highways and wildland-urban interface areas) or involve land-intensive activities (such as cross-country, or open, off-highway vehicle use).

3.17.2 US Department of Agriculture, Forest Service Visual Resources

The Scenery Management System, described in FS Agriculture Handbook 701, outlines the process for inventorying and analyzing aesthetic values on NFS lands (FS 1995b). Scenic resources are defined as attributes, characteristics, and features of landscapes that provide varying responses from, and varying degrees of benefits to, humans.

Scenic integrity is the state of naturalness or, conversely, the state of disturbance created by human activities or alteration (FS 1995b). Integrity is stated in degrees of deviation from the existing landscape character in a National Forest. Scenic integrity is a continuum ranging over the following five scenic integrity levels:

- Very high (unaltered): Refers to landscapes where the valued landscape character is intact with only minute, if any, deviations. The existing landscape character and sense of place is expressed at the highest possible level.
- High (appears unaltered): Refers to landscapes where the valued landscape character appears intact. Deviations may be present but must repeat the form, line, color, texture, and pattern common to the landscape character so completely and at such scale that they are not evident.
- Moderate (slightly altered): Refers to landscapes where the valued landscape character appears slightly altered. Noticeable deviations must remain visually subordinate to the landscape character being viewed.
- Low (moderately altered): Refers to landscapes where the valued landscape character appears moderately altered. Deviations begin to dominate the valued landscape character being viewed, but they borrow valued attributes such as size, shape, edge effect, and pattern of natural openings; vegetative type changes; or architectural styles outside the landscape being viewed. They should not only appear as valued character outside the landscape being viewed but compatible or complimentary to the character within.
- Very low (heavily altered): Refers to landscapes where the valued landscape character appears heavily altered. Deviations may strongly dominate the valued landscape character. They may not borrow from valued attributes such as size, shape, edge effect, and pattern of natural openings; vegetative type changes; or architectural styles within or outside the landscape being viewed. However, deviations must by shaped and blended with the natural terrain (landforms) so that elements such as unnatural edges, roads, landings, and structures do not dominate the composition.

There is also an unacceptably low scenic integrity level. It refers to landscapes where the valued landscape character being viewed appears extremely altered. Deviations are extremely dominant and borrow little, if any, form, line, color, texture, pattern, or scale from the landscape character. Landscapes at this level of integrity need rehabilitation. This level should only be used to inventory existing integrity and should not be used as a management objective.

General Description of Scenic Resources by Scenic Integrity Level

Both very high and high scenic integrity levels are for areas where primitive scenic resources are found. Typically, the foreground, middleground, and background distance zones have an undisturbed appearance. These areas are more remote and are used for low impact activities, such as hiking.

Moderate scenic integrity level areas are for areas where relatively natural scenic resources are found. Typically, the distant middleground and background distance zones have alterations to scenic resources that are visible but difficult to identify. Some effort is needed to access these areas.

Both low and very low scenic integrity levels are for areas where scenic resources are altered by human activities and structures. Typically, the foreground, middleground, and background distance zones have disturbances to scenic resources that are readily noticeable. These areas are readily accessible due to the presence of roads and are used for high-impact activities, such as OHV recreation.

Scenic integrity level objectives outlined in forest plans identify how scenic resources are to be managed. The objectives vary depending on the location, quality, uniqueness, sensitivity, and desired use of the scenic resources.

3.17.3 Other Visual Resources

Management of visual resources on non-BLM and non-FS lands is likely to be influenced by local planning documents. For example, county general plans typically contain elements that address, for example, conservation of natural resources or open space. In areas with hilltops and ridgelines, general plans can include actions that restrict development that would result in skylining (or silhouetting) of structures on hilltops and ridgelines. In areas with scenic roadways, general plans can include actions intended to maintain the attractiveness of the roadway. Also, in areas with valleys or expansive vistas, general plans can include actions to protect structures from blocking or altering these views. Furthermore, local planning documents have recently begun addressing nighttime lighting in order to minimize light pollution, as well as to conserve energy. Light pollution can be defined as any adverse effect of artificial light, including sky glow, glare, light trespass, light clutter, and decreased visibility at night.

3.18 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

3.18.1 Socioeconomic Influences of Geothermal Development and Operation

The construction and operation of geothermal power plants contributes to local, state, and national economies through the creation of jobs, generation of property taxes, payments of revenues, and voluntary contributions to local communities. The construction of direct-use facilities also contributes to economies through job creation and property tax generation. While estimates on the economic impacts of direct-use facilities are not available, a description of the impacts of geothermal electrical generation on economies is described below.

Jobs

Areas of high geothermal potential are often located in rural areas, which typically have chronic, high unemployment rates. The development of geothermal resources in such rural areas can improve local socioeconomic conditions. The construction of a 50-megawatt geothermal power plant could create several hundred temporary construction and related development jobs that would last from two to three years. Between 30 and 50 permanent, high-skilled, full-time jobs at the facility would pay well above minimum wage. Such a development project should provide approximately 90 to 150 new full-time jobs in the community after considering the economic multiplier effect; the idea that a single expenditure in an economy can have repercussions throughout the entire economy The long lifetime of geothermal plants means that they can become a stable, reliable part of a community's economic base (National Geothermal Collaborative 2007).

Property Tax

The development of a geothermal power plant represents a large capital investment in the county in which it is constructed. These plants can generate substantial property taxes for the local county, and considering that many geothermal development locations are in rural areas, the additional revenue stream can result in a substantial increase in the county's tax base (National Geothermal Collaborative 2007). Property taxes are based on the estimated value of the company assets. In 2003, the Geysers, the largest complex geothermal power plant in the world (located north of San Francisco), paid property taxes to two counties totaling more than $11 million. At the geothermal power plants in Inyo County, California, plant owners pay approximately $6 million annually, of which roughly two-thirds is used to fund schools (Kagel 2006). The 10 geothermal power plants installed in Imperial County, California, have a capacity of 330 megawatts and generate approximately $10 million annually in property tax, which represents 20 percent of the county's total property tax revenue (National Geothermal Collaborative 2007).

Revenue Payments

Revenues are monies paid by a geothermal developer to the owner of the leased land on which a power plant operates. Revenues include lease sales and rental fees, bonus bids, and royalties or direct use fees. Royalties are based on a percentage of a developer's revenues, currently set at 1.75 percent of gross revenue from electricity sales for the first 10 years of a lease, and 3 percent thereafter for federal lands for competitive geothermal leases issued under the Energy Policy Act of 2005 and non-producing leases that elect to convert to the new royalties. Producing leases and those noncompetitive lease applications that were grandfathered and those producing leases that do not convert to the new royalty rate will continue to pay a royalty of 10 percent of net proceeds. The 1970 Geothermal Steam Act mandates that in states where the federal government collects geothermal revenues, 50 percent of the total shall be returned to the state in which the resource is located. Based on 2005 amendments, the remaining 50 percent will be equally divided between the county and federal government (Federal Register 2007). As an example of the scale of revenues being generated, in fiscal year 2007, Nevada had approximately 235 megawatts of geothermal electric-generating capacity on government lands, which provided 5.5 percent of the state's power. In that year alone, Nevada received $8.8 million in revenues (competitive lease sales = $5.7 million, royalties = $2.5 million, and lease rentals = $623.8 thousand) of which the counties received $4.4 million (US DOI MMS 2007, BLM 2007a).

Voluntary Payments

Geothermal companies often donate funds to the communities in which they are located. In California, the Mammoth Pacific power plant has been designated a "good neighbor" by many locals for its financial contributions to local groups and for building a new community center from the power plant's proceeds (Kagel 2006).

3.18.2 Socioeconomic Influences of Existing Geothermal Power Plants

As of 2004, geothermal represented approximately one percent of the electricity-generating capacity in the project area, excluding Alaska, equating to approximately 3,195 megawatts (Western Governors' Association 2006). By using the relationships described above between the size of power plants and produced economic stimulus, the following are estimates of the existing contribution of geothermal power plants to economies in the project area:

- Jobs: between 1,917 and 3,195 permanent, full-time jobs that pay above minimum wage, using the ratio of approximately 30 to 50 full-time jobs for a 50-megawatt power plant, as described above;
- Property taxes: approximately $96.8 million annually at the rate generated in Imperial County, California, as described above; and
- Revenue Payments: approximately $230 million annually at the rate generated in Nevada, as described above.

3.18.3 Existing Project Area Socioeconomic Conditions

The use of project area public and NFS lands for geothermal energy development affects the demographic characteristics and economies of the project area. Additionally, social structure and values within the project area shape the demand and opportunities created by public and NFS lands. For these reasons, demographic, economic, and social data for the project area are presented in this section.

Socioeconomic resources include historic, current, and forecasted population statistics, race/ethnicity, age distribution, housing, and poverty. Such data provide background on population growth, distribution of racial/ethnic minorities and low-income groups, and population aging. These factors are reflected in the project area's economics and social values. Economic development is measured through employment, personal income, tax revenues (sales and state income), gross state product, and government revenues and expenditures. For each development measure, data is presented for a selection of years with available data between 1990 and 2006 to provide historical trends for the project area. Forecasts for each measure provide future expectancy of each measure. It should be noted that the forecasts presented are estimates based on past annual rates only and do not attempt to factor in the variety of economic and social factors that are likely to influence future growth in each development measure. In addition, dollar amounts presented are not adjusted for inflation.

Due to the nature of Census data, economic statistics could not be obtained specifically for the planning area; trends for the planning area are assumed to reflect the same general trends seen in the project area.

Population

Total project area population was estimated at 68.3 million in 2006 and is expected to reach over 80 million by 2015 and 95 million by 2025. California had the highest population concentration in the project area with more than 53 percent of the project area's total population in 2006. Table 3-29, Total Project Area Population (in millions), displays population trends from 1990 to 2006, as well as population forecasts for 2015 and 2025.

The project area's population grew at an annual average rate of 2 percent between 1990 and 2006. The largest population growth occurred in Nevada with a 6.7-percent increase, while the lowest growth occurred in Montana and Wyoming, with .7 and .8 percent increases, respectively. Relatively high growth rates in the remaining states were estimated for Arizona (3.3 percent), Utah (2.6 percent), Idaho (2.6 percent), and Colorado (2.4 percent). Close-to-average growth occurred in New Mexico (1.8 percent), Oregon (1.8 percent), and Washington (1.7 percent), with lower-than-average growth rates in the remaining states.

Table 3-29
Total Project Area Population (in millions)

State	1990	2006	Average Annual Growth Rate 1990-2006 (%)	2015 (Projected)	2025 (Projected)
Alaska	0.6	0.7	1.0	0.7	0.8
Arizona	3.7	6.2	3.3	7.5	9.5
California	29.8	36.5	1.3	40.0	44.3
Colorado	3.3	4.8	2.4	5.0	5.5
Idaho	1.0	1.5	2.6	1.6	1.9
Montana	0.8	0.9	0.7	1.0	1.1
Nevada	1.2	2.5	4.7	3.1	3.9
New Mexico	1.5	2.0	1.8	2.0	2.1
Oregon	2.8	3.7	1.8	4.0	4.5
Utah	1.7	2.6	2.7	2.8	3.2
Washington	4.9	6.4	1.7	7.0	8.0
Wyoming	0.5	0.5	0.8	0.5	0.6
Project Area	**51.5**	**68.3**	**1.8**	**80.0**	**95.0**

Source: US Bureau of the Census 2007a

Age Distribution

As illustrated in Table 3-30, Project Area Age Distribution (2006), the project area's median age in 2006 was 32.4 years, with Montana (39.2 years) and Utah (28.3 years) having the highest and lowest median ages, respectively. Approximately 24 percent of the project area's population was children (under 18 years of age), while slightly over 10 percent of the project area's population were older than 65 years. Utah, at 31.1 percent, possessed the highest percentage of children in 2006, followed by Idaho (26.9 percent), Alaska (26.8 percent), Arizona (26.4 percent), California (26.1 percent), and New Mexico (26.1 percent). The number of children in the remaining states was close to the project area average (within 2 percentage points). Alaska and Utah, at 6.8 percent and 8.8 percent, respectively, contributed to the smallest population percentage whose age was over 65 years, while Montana (at 13.8 percent) had the highest number of elderly in the project area. The remaining states had an elderly population near the project area's average.

Table 3-30
Project Area Age Distribution (2006)

State	Median Age	Percent Children (under 18 Years of Age)	Percent Elderly (over 65 Years of Age)
Alaska	33.4	26.8	6.8
Arizona	34.6	26.4	12.8
California	34.4	26.1	10.8
Colorado	35.4	24.6	10.0
Idaho	34.2	26.9	11.5
Montana	39.2	23.1	13.8
Nevada	35.5	25.4	11.1
New Mexico	35.3	26.1	12.4
Oregon	37.5	23.2	12.9
Utah	28.3	31.1	8.8
Washington	36.7	23.9	11.5
Wyoming	37.1	23.5	12.2
Project Area	**35.13**	**25.59**	**11.22**

Source: US Bureau of Census 2007a

Vacant Housing

Table 3-31, Project Area Available Housing Units (in thousands), shows the number of vacant housing units in 1990 and 2000, with the percent change over the 10-year period, as well as the projected vacant housing of the project area in 2010. The number of total vacant housing units in the project area was estimated at 1.9 million in 2000; vacant housing units are expected to drop off to 1.8 million by 2010. California, with the largest population in the project area, also had the largest number of available housing units. Vacant housing units in California were estimated at 711,700 in 2000 (almost 40 percent of the project area's total), but are expected to decrease to 633,500 by 2010. Arizona, with 288,000 units, and Washington, with 180,000 units, had the next-largest numbers of vacant units after California.

There was a slight decline in the number of vacant housing units between 1990 and 2000, with a total annual growth rate of -0.26 percent for the project area. Most states experienced a decline in available housing units between 1990 and 2000. States with higher-than-average annual drops in vacant units were Colorado (-2.6 percent), Wyoming (-1.4 percent), California (-1.2 percent), and Alaska (-1.0 percent), while states such as Nevada (3.8 percent), Oregon (2.8 percent), and New Mexico (1.4 percent) experienced fairly large increases in vacant housing units.

Table 3-31
Project Area Available Housing Units (in thousands)

State	1990	2000	Average Annual Growth Rate 1990-2000 (%)	2010 (Projected)
Alaska	43.7	39.4	-1.0	35.5
Arizona	290.6	287.9	-0.1	285.2
California	801.7	711.7	-1.1	631.8
Colorado	194.9	149.8	-2.3	114.9
Idaho	52.6	58.2	1.1	64.6
Montana	55.0	54.0	-0.1	53.0
Nevada	52.6	76.3	4.5	110.6
New Mexico	89.3	102.6	1.4	117.9
Oregon	90.3	119.0	3.2	157.0
Utah	61.1	67.3	1.0	74.1
Washington	160.0	179.7	1.2	201.8
Wyoming	34.6	30.2	-1.3	26.3
Total	**1926.4**	**1876.1**	**-0.26**	**1,827.8**

Source: US Bureau of Census 2007a

Employment

Between 1990 and 2006, project area labor force and employment grew by 1.7 percent, while unemployment dropped slightly. Tables 3-32, Project Area State Labor Force and Employment (in millions), and 3-33 Project Area State Unemployment (in millions), show employment and unemployment data for the project area, between 1990 and 2006. Employment growth rates were highest in Nevada (4.4 percent) and Arizona (3.2 percent) than the rest of the project area. Growth rates in Montana (1.4 percent) and California (1.1 percent) were less than the project area's average growth.

Almost 53 percent (16.9 million) of all project area (32.2 million) employment was concentrated in California. Employment in Washington, Arizona, and Colorado in 2006 stood at 3.1 million, 2.8 million, and 2.1 million respectively; the remaining states supported less than 7 million jobs. Employment in the project area as a whole is projected to increase to 37 million in 2014; California is expected to provide 50 percent (18.4 million) of project area employment by 2014. Unemployment rates dropped for all states except Oregon; the highest drop in unemployment rates occurred in Wyoming and Montana.

Table 3-32
Project Area State Labor Force and Employment (in millions)

	Labor Force			Employment			
State	**1990**	**2006**	**Average Annual Growth Rate 1990-2006 (%)**	**1990**	**2006**	**Average Annual Growth Rate 1990-2006 (%)**	**2014 (Projected)**
Alaska	0.27	0.35	1.6	0.25	0.32	1.5	0.4
Arizona	1.8	2.9	3.8	1.7	2.8	3.1	3.6
California	15.0	17.8	1.1	14.2	16.9	1.1	18.4
Colorado	1.7	2.6	2.7	1.7	2.5	2.4	3.0
Idaho	0.5	0.7	2.1	0.5	0.7	2.1	0.8
Montana	0.4	0.5	1.4	0.4	0.5	1.4	0.6
Nevada	0.6	1.3	5.0	0.6	1.2	4.3	1.7
New Mexico	0.7	0.9	1.6	0.7	0.9	1.6	1.0
Oregon	1.5	1.9	1.5	1.4	1.8	1.6	2.0
Utah	0.8	1.3	3.1	0.8	1.2	2.5	1.5
Washington	2.5	3.3	1.8	2.4	3.1	1.6	3.5
Wyoming	0.2	0.3	2.6	0.2	0.3	2.5	0.4
Total	**26.0**	**33.9**	**1.7**	**24.9**	**32.2**	**1.6**	**36.9**

Source: US Department of Labor 2007a, 2007b

Table 3-33
Project Area State Unemployment (in millions)

State	**1990**		**2006**	
	Unemployment	**Unemployment Rate**	**Unemployment**	**Unemployment Rate**
Alaska	0.02	7.2	0.02	7.0
Arizona	0.09	5.1	0.10	4.4
California	0.80	5.1	0.90	5.1
Colorado	0.01	5.2	0.10	4.7
Idaho	0.03	5.3	0.03	3.7
Montana	0.02	6.0	0.02	3.5
Nevada	0.03	4.7	0.05	4.1
New Mexico	0.05	6.7	0.04	4.7
Oregon	0.08	4.9	0.10	5.5
Utah	0.03	4.3	0.04	3.4
Washington	0.10	5.1	0.20	4.9
Wyoming	0.01	5.7	0.01	3.0
Total	**1.3**	**5.0**	**1.61**	**4.9**

Source: US Department of Labor 2007a, 2007b

Personal Income

Table 3-34, Project Area State Personal Income indicates that personal income in the project area grew by 5.9 percent between 1996 and 2006. Growth rates in personal income were highest in Nevada (8.4 percent) over the 10-year period; growth rates in the remaining 11 states were within 1.7 percent of the project area's average rate of 5.9 percent.

California, with a personal income growth rate at 5.9 percent in the 10-year period, generated almost 60 percent of the project area's personal income, producing almost $1.4 trillion in 2006. Personal income in California is expected to reach $1.8 trillion by 2010. For the project area as a whole, personal income is expected to increase from $2.5 trillion in 2006 to $3.2 trillion in 2010.

Table 3-34
Project Area State Personal Income (in billions of dollars*)

State	1996	2006	Average Annual Growth Rate 1996-2006 (%)	2010 (Projected)
Alaska	15.7	25.9	5.1	31.6
Arizona	95.5	197.0	7.5	263.2
California	810.4	1,434.9	5.9	1,803.3
Colorado	100.2	188.2	6.5	242.2
Idaho	24.4	43.9	6.1	55.5
Montana	16.9	29.2	5.6	36.3
Nevada	43.5	97.4	8.4	134.5
New Mexico	33.3	58.1	5.7	72.6
Oregon	76.0	123.1	4.9	149.3
Utah	40.4	75.9	6.5	97.7
Washington	139.7	243.5	5.7	304.1
Wyoming	10.7	20.9	6.9	27.3
Total	**1406.5**	**2,538.0**	**5.9**	**3186.07**

* not adjusted for inflation
Source: US Department of Commerce 2007b

Gross State Domestic Product

The total value of goods and services produced in each state, or gross state product, was estimated at $3,080 billion for the project area in 2006 and is expected to reach $3,866 billion by 2010 (Table 3-35, Project Area Total Gross Domestic Product). More than 56 percent ($1,727 billion) of total gross state product was produced in California in 2006.

Table 3-35
Project Area Total Gross Domestic Product (in billions of dollars*)

State	1990	2006	Growth Rate 1990-2006 (%)	2010 (Projected)
Alaska	24.9	41.1	3.2	47.0
Arizona	69.3	232.5	7.9	314.7
California	788.3	1,727.4	5.0	2,101.7
Colorado	74.2	230.5	7.3	306.0
Idaho	17.8	49.9	6.7	64.6
Montana	13.4	32.3	5.7	40.2
Nevada	31.8	118.4	8.7	164.4
New Mexico	26.9	75.9	6.7	98.3
Oregon	57.3	151.3	6.3	192.9
Utah	31.4	97.7	7.4	129.8
Washington	115.6	293.5	6.0	370.5
Wyoming	13.1	29.6	5.2	36.3
Total	**1264.0**	**3080.1**	**5.57**	**3,866.0**

* not adjusted for inflation
Source: US Department of Commerce 2007a

Total project area production grew at a rate of 5.57 percent between 1990 and 2006. The gross state product growth rate was uneven across the project area states, with higher-than-average rates for Nevada (8.7 percent), Arizona (7.9 percent), Utah (7.4 percent), and Colorado (7.3 percent). Below-average growth rates occurred in Wyoming (5.2 percent), California (5.0 percent), and Alaska (3.2 percent).

State Income Tax Revenues

As shown in Table 3-36, Project Area State Income Tax Revenues, the majority of the project area experienced moderately large annual increases in income tax revenues between 1996 and 2006. Increases in California (13.3 percent) were higher than the project area average (12.2 percent); whereas Idaho (7.5 percent) and Montana (8 percent) experienced relatively slow increases in income tax revenues. While increases in Alaska were high at, 16.6 percent, it should be noted that Alaska has no personal tax income, therefore this data reflects only corporate tax income data.

In 2006, California produced $61.5 billion in income taxes, generating 74 percent of total state income tax revenues in the project area. Oregon was the second-largest state income tax producer with $5.9 billion in 2006. Revenues for the entire project area are projected to increase from $83.4 billion in 2006

Table 3-36
Project Area State Income Tax Revenues (in billions of dollars*)

Including Personal and Corporation Income tax unless otherwise noted

State	1996	2006	Average Annual Growth Rate 1996-2006 (%)	2010 (Projected)
Alaska[1]	0.3	0.8	16.6	1.2
Arizona	1.9	4.1	8.0	5.6
California	26.6	61.5	13.1	86.0
Colorado	2.5	4.7	8.8	6.1
Idaho	0.8	1.4	7.5	1.8
Montana	0.5	0.9	8.0	1.1
Nevada[2]	-	-	-	-
New Mexico	0.8	1.5	8.7	1.9
Oregon	3.1	5.9	9.0	7.6
Utah	1.3	2.6	10.0	3.4
Washington[2]	-[a]	-	-	-
Wyoming[2]	-[a]	-	-	-
Total	**37.8**	**83.4**	**12.1**	**114.5**

* Not adjusted for inflation

[1]There are no personal or corporate state income taxes in Nevada, Washington, Wyoming.

[2]There are no personal state income taxes in Alaska, data reflects corporation net income tax only.

Source: US Bureau of Census 2007b

to $114.5 billion in 2010. Revenues in California are expected to reach $86 billion in 2010.

Sales Tax Revenues

Total sales tax revenues for the project area are projected to grow from $57.7 billion in 2006 to $74.8 billion in 2010 (Table 3-37, Project Area State Sales Tax Revenues)Between 2002 and 2010, sales tax revenues are expected to grow for each individual state, with revenues in the largest generating state, California, projected to reach $40 billion in 2010.

During the period from 1997 to 2002, higher-than-average annual growth in sales tax revenues occurred in Arizona (9.6 percent), Wyoming (10.0 percent), Nevada (10 percent), and California (6.9 percent). The average annual growth rate for the project area as a whole during this period was 6.7 percent.

Table 3-37
Project Area General State Sales Tax Revenues (in billions of dollars*)

State	1996	2006	Growth Rate 1997-2006 (%)	2010 (Projected)
Alaska[1]	-	-	-	-
Arizona	2.7	5.3	9.6	7.20
California	19.0	32.1	6.9	40.0
Colorado	1.3	2.1	6.1	3.3
Idaho	0.9	1.1	5.1	1.5
Montana[1]	-	-	-	-
Nevada	1.6	3.2	10.0	4.7
New Mexico	1.3	1.7	3.1	1.9
Oregon	-	-	-	-
Utah	1.2	1.9	5.8	2.4
Washington	6.2	10.0	6.1	12.7
Wyoming	0.3	0.6	10.0	.88
Total	**34.5**	**57.7**	**6.7**	**74.8**

* not adjusted for inflation
[1]There are no general state sales taxes in Alaska, Montana or Oregon.
Source: US Bureau of Census 2007b

State and Local Government Expenditures

Funding for state and local government services for the project area in 2002 was concentrated in California at $293.3 billion, 60 percent of the total amount of $504.9 billion for the project area (Table 3-38, Project Area Total State and Local Government Expenditures). Other states with relatively large state and local government expenditure are Washington ($50.4 billion), Colorado ($32.4 billion), Arizona ($31.9 billion), and Oregon ($27.7 billion).

Annual growth rates in state and local government expenditures have increased fairly rapidly throughout the project area, with an overall annual average rate of 8.0 percent over the period of 1997 to 2002. Colorado's growth rate at 9.5 percent was more than one percentage point higher than the project area average, while growth rates in Alaska (4.6 percent) and Montana (5.0 percent) were relatively low during the period.

Table 3-38
Project Area Total State and Local Government Expenditures (in billions of dollars*)

State	1997	2002	Average Annual Growth Rate 1997-2002 (%)	2010 (Projected)
Alaska	7.5	9.4	4.6	13.5
Arizona	21.2	31.9	8.5	61.3
California	196.0	293.3	8.4	559.0
Colorado	20.6	32.4	9.5	66.9
Idaho	5.4	7.6	7.1	13.1
Montana	4.4	5.6	5.0	8.2
Nevada	9.2	14.0	8.8	27.4
New Mexico	9.3	12.7	6.4	20.9
Oregon	19.9	27.7	6.8	47.0
Utah	10.8	15.5	7.5	27.6
Washington	36.1	50.4	6.9	86.0
Wyoming	3.2	4.3	6.1	6.9
Total	**343.6**	**504.9**	**9.3**	**934.2**

* not adjusted for inflation
Source: US Bureau of Census 2007c

Alternative Economic Values

In addition to traditional development that provides employment and income to the rural west, an economic value can be attributed to the project area for its amenities. Likewise, some cost can be attributed for the protection of these values. Amenities are those features, either developed or undeveloped, that attract visitors to an area (e.g., recreation opportunities, wildlife viewing, solitude, etc.). Recreation (both individual and commercial) and tourism support local and niche businesses throughout public and FS lands. This type of income is dependant on the open space to support the amenities that attract recreationists and others in search of this locale.

State and Local Government Employment

State and local government employment data for 1995 and 2006 have been recorded in Table 3-39, Project Area Total State and Local Government Employment (in thousands). As shown in the table, growth in government employment in the project area has been varied over the 11-year period. The overall annual employment growth for the project area stood at 1.8 percent over the period, while states such as Nevada increased their employment by 3.1 percent, with a slightly smaller but still large increase in Arizona (2.4 percent).

Table 3-39
Project Area Total State and Local Government Employment (in thousands)

State	1995	2006	Average Annual Growth Rate 1995-2006 (%)	2010 (Projected)
Alaska	45.6	52.6	1.4	55.4
Arizona	218.8	285.1	2.4	313.9
California	1,479.6	1,818.7	1.9	1,960.4
Colorado	204.9	255.0	2.0	276.1
Idaho	67.1	79.4	1.5	84.4
Montana	56.3	54.2	-.3	53.5
Nevada	73.5	103.3	3.1	116.9
New Mexico	110.7	127.9	1.3	134.8
Oregon	166.1	181.7	.8	187.7
Utah	104.8	128.8	1.9	138.8
Washington	283.2	333.2	1.5	353.5
Wyoming	37.9	45.8	1.7	49.1
Total	**2,848.5**	**3,465.7**	**1.8**	**3,721.9**

Source: US Bureau of Census 2007c

The majority of the states were within half a percentage point of the total project area growth, while Oregon (.8 percent) saw slower growth and Montana (-.3 percent) experienced a decline in government employment.

California's government employment stood at 1.8 million in 2006, holding 52 percent of project area's total, and is expected to reach 2.0 million in 2010. Other states with relatively large totals of government employees in 2006 were Washington (333,200), Arizona (285,100), and Colorado (255,000). Total employment in the project area was more than 3.4 million in 2006 and is expected to exceed 3.7 million in 2010.

Environmental Justice

As required by NEPA, and specifically in accordance with Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations, federal agencies must incorporate environmental justice as part of their missions. This section addresses topics related to environmental justice, providing specific information on economic, racial, and demographics in and around the project area to identify areas of low-income and high-minority populations.

A summary of the geographic distribution of low-income and minority populations, based on the demographic data from the 2006 American Community Survey (US Bureau of the Census 2007a) for each project area state is presented in Table 3-40, Project Area Minority and Low-income Population Composition. For the data presented in this table, the following definitions describe low-income and minority population categories:

- Minority: The minority category includes persons who classify themselves as belonging to any of the following racial groups: Hispanic or Latino, Black or African American, American Indian or Alaskan Native, Asian, Native Hawaiian or Other Pacific Islander, and some other race (non-White). The term minority includes all persons classifying themselves in various racial categories, except those identifying themselves as not of Hispanic origin and as White or Other Race (US Bureau of Census 2007a).
- Low-Income: The Bureau of Census determines which families or individuals are poor using a set of money income thresholds, taking into account family size and composition. Those families or individuals that fall below their relevant poverty threshold are considered low income.

In 2006, the project area minority population was estimated at 30 million (44.3 percent of total project area population). Some individual states hosted a relatively large number of minority individuals. Of total population in New Mexico, 57.6 percent were considered minority, followed by 57.2 percent in California, 41.4 percent in Nevada, and 40.5 percent in Arizona. In each of the above states, as well as the project area as a whole, the Hispanic population dominated the minority ethnic groups. Of all the states, New Mexico and California have minority populations that exceed the project area minority population, as well as exceeding half of the total population of each state. Montana (11.4 percent), Wyoming (12.0 percent), Idaho (13.7 percent), Utah (17.2 percent), and Oregon (19.2 percent) have minority populations well (more than 20 percentage points) below the project area average.

The project area poverty (low-income) rate is estimated at 12.9 percent, exceeding the poverty rates of more than half of the project area states. States with poverty rates higher than the average for the project area are New Mexico (18.5 percent), Arizona (14.2 percent), Oregon (13.3 percent), Montana (13.6 percent), and California (13.1 percent). Out of all the project area states, New Mexico (at 18.5 percent) holds the highest poverty rate, while Wyoming has the lowest poverty rate (9.4 percent).

Table 3-40
Project Area Minority and Low-income Population Composition

Parameter	Alaska	Arizona	California	Colorado	Idaho	Montana
Total Population	670,053	6,166,318	36,457,549	4,753,377	1,466,465	944,632
White, Non-Hispanic	443,944	3,668,571	15,600,175	3,400,011	1,265,241	836,541
Hispanic or Latino	37,498	1,803,377	13,074,155	934,410	138,871	20,513
Non-Hispanic or Latino Minorities	188,611	694,370	7,783,219	418,956	62,353	87,578
One race	140,871	610,190	7,065,079	340,937	37,384	70,035
Black or African American	20,419	198,854	2,201,043	170,995	6,105	4,327
American Indian or Alaskan Native	86,688	252,214	168,486	29,223	13,708	58,034
Asian	29,622	139,386	4,424,529	127,082	14,884	5,509
Native Hawaiian or Other Pacific Islander	3,526	9,326	120,837	3,700	2,021	763
Some other race	616	10,410	150,184	9,937	666	1,402
Two or more races	47,740	84,180	718,140	78,019	24,969	17,543
Total minority	226,109	2,497,747	20,857,374	1,353,366	201,224	108,091
Low-income	73,036	875,617	4,775,939	570,405	184,774	128,470
Percent minority	33.7	40.5	57.2	28.5	13.7	11.4
Percent low-income	10.9	14.2	13.1	12.0	12.6	13.6

Table 3-40
Project Area Minority and Low-income Population Composition

Parameter	Nevada	New Mexico	Oregon	Utah	Washington	Wyoming	Project Area
Total Population	2,495,529	1,954,599	3,700,758	2,550,063	6,395,798	515,004	*68,070,145*
White, Non-Hispanic	1,463,452	828,965	2,989,235	2,112,440	4,886,203	453,251	*37,948,029*
Hispanic or Latino	610,051	860,687	379,034	286,113	580,027	35,732	*18,760,468*
Non-Hispanic or Latino Minorities	422,026	264,947	332,489	151,510	929,568	26,021	*11,361,648*
One race	366,233	243,503	244,073	118,698	752,915	19,189	*10,009,107*
Black or African American	178,999	35,849	60,985	21,303	211,333	3,269	*3,113,481*
American Indian or Alaskan Native	26,393	176,968	36,631	27,061	83,313	10,497	*969,216*
Asian	146,075	23,557	134,601	47,871	418,886	4,311	*5,516,313*
Native Hawaiian or Other Pacific Islander	9,871	1,053	7,934	18,958	26,691	350	*205,030*
Some other race	4,895	6,076	3,922	3,505	12,692	762	*205,067*
Two or more races	55,793	21,444	88,416	32,812	176,653	6,832	*1,352,541*
Total minority	1,032,077	1,125,634	711,523	437,623	1,509,595	61,753	*30,122,116*
Low-income	257,040	361,601	492,201	270,307	754,704	48,410	*8,792,504*
Percent minority	41.4	57.6	19.2	17.2	23.6	12.0	*44.3*
Percent low-income	10.3	18.5	13.3	10.6	11.8	9.4	*12.9*

Source: US Bureau of Census 2007a

3.19 HEALTH AND SAFETY

This section describes health and safety concerns associated with geothermal energy development. Also discussed is the regulatory framework around health and safety of workers involved with geothermal energy development.

3.19.1 Applicable Plans, Policies and Regulations

Occupational health and safety issues pertaining to geothermal resource development include exposure to geothermal gases, confined spaces, heat, and noise. Occupational health and safety rights for individuals are protected through the federal Occupational Safety and Health Act (29 USC 651 et seq.). Under this act, Congress created the Occupational Safety and Health Administration (OSHA), an agency of the US Department of Labor. The OSHA's mission is to assure the safety and health of America's workers by setting and enforcing standards; providing training, outreach, and education; establishing partnerships; and encouraging continual improvement in workplace safety and health. States may have additional laws and regulations that build on the Occupational Safety and Health Act.

Hazardous and toxic substances would be used and generated during the various phases of geothermal resource development. These substances have hazardous physical and chemical properties (e.g., ignitability, corrosivity, reactivity) and may also have high toxicity. There are numerous federal laws that regulate hazardous and toxic substances. Of these laws, the most far reaching are discussed below. States may also have additional laws that regulate the management of hazardous and toxic substances.

Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a hazardous substance is any material the US EPA has designated for special consideration under the Clean Air Act, Clean Water Act, Toxic Substances Control Act, or Resource Conservation and Recovery Act (US EPA 2007e). The US EPA also may designate additional substances as being hazardous under CERCLA. Hazardous wastes or substances can be hazardous to human health or the environment when they are improperly managed and possess at least one of four characteristics (ignitability, corrosivity, reactivity, or toxicity) or appear on other EPA lists of substances deemed to be hazardous in some way.

The Resource Conservation and Recovery Act is a federal law enacted in 1976. Three primary goals of the Act are to protect human health and the environment from the potential hazards of waste disposal, to reduce the amount of waste generated, and to ensure that wastes are managed in an environmentally sound manner (US EPA 2006). In 1984, Congress enacted the Hazardous and Solid Waste Amendments, which expanded the scope of the Act by implementing management for hazardous wastes from their manufacture all the way through to their final disposal.

3.19.2 Typical Hazards of the Geothermal Industry

There are physical hazards associated with all phases of geothermal development: exploration, development, operation, and close out. Many of the hazards associated with geothermal energy development are shared by other energy industries. Existing hazards are usually associated with site excavation, road building, exploration drilling, flow testing, well venting, power plant construction, power plant operation, and transmission line construction. Thermal hazards are also present whenever working with heated fluids. Adherence to safety standards and use of protective equipment can reduce occupational hazards and the chance of burns from geothermal fluids, but work-related injuries and fatalities can still occur.

Chemical hazards associated with naturally occurring contaminants may also be present in geothermal fluids. Human exposure may occur during the exploration, development, operation, or close out phases of a geothermal project. Health effects may be acute or chronic, and exposure may be via inhalation of geothermal steam or ingestion of geothermal fluids (drinking contaminated water). Watson and Etnier (1981) report that the most frequent and severe of reported injuries to geothermal workers is dermal exposure to caustic sludges produced by H_2S abatement systems.

Inhalation of Noncondensable Gases

The primary human health issue within the geothermal energy working environment is the inhalation of noncondensable gases that form when geothermal fluids turn to steam. Steam is produced during drilling, flow testing, well venting, and cooling of geothermal fluids as part of standard power plant operations. The primary gas of concern is hydrogen sulfide, while others such as mercury, radon, and benzene are also present but are typically not at levels considered hazardous to human health.

Total noncondensable gas emissions from geothermal resources typically comprise less than five percent of the total steam emitted (Reed and Renner 1995). Binary power plants reinject all geothermal fluids into the reservoir, thereby eliminating emissions concerns; however, emissions do occur during flow testing and well venting.

Hydrogen Sulfide

Hydrogen sulfide emissions have resulted in complaints of odor annoyance and health impairment. The OSHA has established an acceptable maximum concentration of 20 parts per million (ppm) for hydrogen sulfide in the workplace, with a maximum level of 50 ppm allowed for 10 minutes maximum if no other measurable exposure occurs. The National Institute for Occupational Safety and Health has set a maximum recommended exposure limit ceiling value of 10 ppm for 10 minutes maximum (Agency for Toxic Substances and Disease Registry 2006).

Anspaugh and Hahn (1979) evaluated occupational hazards at the Geysers in California. While this information is nearly 30 years old, the more significant hazards at that time were exposure to toxic chemicals, hazardous materials, and noise. The most significant cause of illness was exposure to the chemicals and wastes associated with hydrogen sulfide abatement. Anspaugh and Hahn concluded that, on a comparative basis, geothermal energy is a relatively benign source of energy. The chemical exposure issues mentioned above are shared by many other energy technologies including oil and gas, oil shale, and nuclear.

Anspaugh and Hahn (1979) also reviewed public health concerns related to the Geysers Geothermal Power Plant. Residents of communities near the Geysers filed public health complaints, most of which were related to annoyance effects, particularly to odor annoyance from hydrogen sulfide. Some residents appeared at hearings held by the California Public Utilities Commission and voiced complaints of headaches, nausea, and sinus congestion. The concentrations of hydrogen sulfide that appear to be responsible for these complaints were about 0.1 ppm, or 100 times lower than the recommended standard for occupational exposure. Whether such low concentrations of hydrogen sulfide can produce actual health effects remains to be proven, but the possibility does exist that some individuals are particularly sensitive.

While abatement systems can reduce levels of hydrogen sulfide, some abatement systems have their own suite of chemicals and wastes, exposure to which can also result in occupational illness. Chemicals used in hydrogen sulfide abatement systems include hydrogen peroxide, caustic soda, and catalytic compounds containing iron and nickel. Waste is primarily sludge made of noncommercial quality sulfur with lesser amounts of other chemicals (Anspaugh and Hahn 1979).

Mercury

Mercury levels vary between geothermal resources and are not present in all geothermal fluids. In those resources containing mercury, power production could result in mercury emissions, depending upon the type of plant. Binary plants do not emit any mercury because all geothermal fluids are reinjected into the geothermal reservoir. Mercury abatement technology is available for power plants using resources with elevated mercury content. State and local governments have introduced measures to reduce mercury emissions from a variety of sources and have resulted in the presence of mercury abatement measures at most geothermal facilities currently in production (Geothermal Energy Association 2007b).

Radon

Radon is a toxic radioactive gas with no color, odor, or taste that forms from the normal decay process of uranium, which is present in most rocks and soil. Radon is present in geothermal fluids and is released to the air from cooling towers. It is generally only a concern in indoor areas where concentrations can build up over time. A study of radon levels at the Geysers concluded that the cooling towers had no discernible effect on ambient radon levels in either nearby communities or in the plant environment itself (Layton and Anspaugh 1981).

Benzene

Benzene is a known carcinogen that is present in some geothermal fluids, but levels are generally within acceptable ranges. The Heber geothermal facility in southern California was required to conduct quarterly benzene cooling tower analysis as a permit condition; however, levels have never been high enough to trigger risk assessments under the California Environmental Protection Agency exposure level standards (Geothermal Energy Association 2007b).

Drilling Hazards

Due to limited research of the geothermal industry, extensive hazard data for geothermal drilling activities are not available. However, drilling hazards associated with the geothermal industry are generally similar to hazards experienced with the well-documented hazards of drilling for the oil and gas industry. Table 3-41 provides a description of the common types of hazards associated with oil and gas drilling.

Table 3-41
Oil and Gas Industry Drilling Hazards that May be Present in the Geothermal Industry

Hazard	Source
Struck by	Falling/moving pipe; tongs and/or spinning chain, kelly, rotary table, etc.; high-pressure hose connection failure causing employees to be struck by whipping hose; tools/debris dropped from elevated location in rig; vehicles
Caught in/between	Collars and tongs, spinning chain, and pipe; clothing gets caught in rotary table/drill string
Fire/Explosion/High pressure release	Well blowout, drilling/tripping out/swabbing etc. results in release of gas that may be ignited if not controlled at the surface; welding/cutting near combustible materials, uncontrolled ignition sources near the well head, e.g., heater in the doghouse, unapproved or poorly maintained electrical equipment; aboveground detonation of perforating gun
Rig collapse	Overloading beyond the rated capacity of the rig; improper anchoring/guying; improper raising and lowering the rig; existing maintenance issues with the rig structure that impacts the integrity

Table 3-41
Oil and Gas Industry Drilling Hazards that May be Present in the Geothermal Industry

Hazard	Source
Falls	Fall from elevated areas of the rig, i.e., stabbing boar, monkey board, ladder, etc.; fall from rig floor to grade
Hydrogen sulfide exposure	Hydrogen sulfide release during drilling, swabbing, perforating operations, etc. resulting in employee exposures; production tank gauging operations, gaugers sometimes exposed to hydrogen sulfide

Source: OSHA 2007

Contamination of Drinking Water Supplies

Another human health concern related to geothermal projects is the potential contamination of underground and surface drinking water supplies with geothermal fluids. The common contaminants in geothermal fluids that are of concern to public health through consumption in drinking water are arsenic, boron, and mercury.

Most geothermal reservoirs are found deep underground, well below groundwater reservoirs. Drilling activities can result in the pollution of shallower water aquifers with drilling fluids as wells are bored through them, although this effect is limited to the duration of drilling. Well casing is used upon well completion, which separates geothermal fluids from any shallower aquifers that a drilled well may pass through. Groundwater contamination can occur in rare situations involving a well casing break or the percolation of surface-discharged geothermal fluids.

Surface water bodies can be contaminated from either surface discharges or spills of geothermal fluids, or underground contamination of springs that feed a surface water body. Surface discharges are regulated through state and local permits, and abatement technologies are installed as necessary to reduce contaminants to acceptable levels.

Construction, Operation, and Maintenance Plan

Construction, operation, and maintenance plans are used to establish procedures and protocols for the safe construction, operation, and maintenance of geothermal resource developments. These plans typically address worker and site safety, emergency response protocols, and procedures for managing hazardous and toxic substances. A construction, operation, and maintenance plan is prepared by the operator of the geothermal energy operation prior to any geothermal resource development. Furthermore, a plan is also used to identify procedures for safely abandoning and properly reclaiming a site during close out.

3.20 Noise

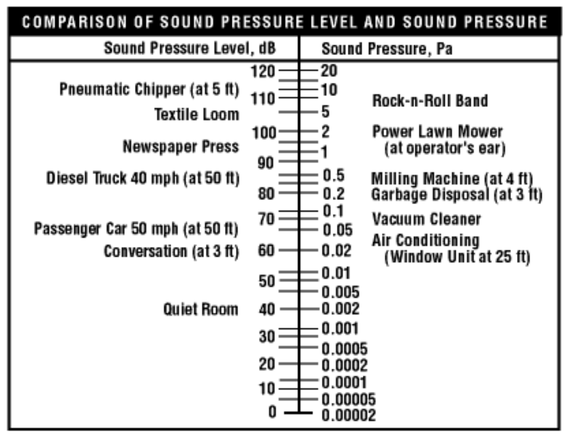
This section describes the environmental noise fundamentals, background noise levels, noise propagation, and noise standards and guidelines related to geothermal resource development.

3.20.1 Fundamentals

Noise is defined as any undesirable sound. Sound is any pressure variation that the ear can detect. Sound pressure levels are measured in units of decibels. Any time a sound level (or sound pressure level) is referred to, a decibel notation is implied.

Audible sounds range from 0 decibel, considered the quietest sound that can be heard by an average person, called the "threshold of hearing," to about 130 decibels, which is considered so loud that it causes pain, and is called the "threshold of pain" (Figure 3-23), Comparison of Sound Pressure Level and Sound Pressure). The perceived pitch of a sound, which characterizes the sound as being high or low when heard, is determined by its frequency. Low-pitched or bass sounds have low frequencies, and high-pitched or treble sounds have high frequencies. A healthy, young person can hear sounds with frequencies ranging from approximately 20 to 20,000 cycles per second (hertz). The sound of human speech is typically in the range 300 to 3,000 hertz (Canada's National Occupational Health and Safety Resource 2008).

Figure 3-23
Comparison of Sound Pressure Level and Sound Pressure[1]



[1] dB = decibel

Source: Canada's National Occupational Health and Safety Resource 2008.

The A-weighted decibel scale estimates the range of human hearing by filtering out lower frequency noises, which are not as damaging as high frequencies. This scale is widely used in noise standards, guidelines, and ordinances, and is widely accepted in analyzing noise and its impacts on humans. Table 3-42, Comparison between Noise Source and Sound Level, provides a comparison between sound pressure levels associated with some familiar sources and geothermal operations.

Table 3-42
Comparison between Noise Source and Sound Level

Noise Source	Sound Level (A-weighted decibel scale)
Near leaves rustling from breeze	25
Whisper at six feet	35
Inside average suburban residence	40
Near a refrigerator	40
Inside average office, without nearby telephone ringing	55
Speech at 3 feet, normal voice level	60
Automobile (60 miles per hour) at 100 feet	65
Vacuum cleaner at 10 feet	70
Garbage disposal at 3 feet	80
Electric lawn mower at 3 feet	85
Food blender at 3 feet	90
Auto horn at 10 feet	100

Source: Geothermal Energy Association 2007a

Although an A-weighted sound may adequately indicate the level of sound at a given instant, it does not account for the duration of the sound or that sound levels can vary with time. To assess these variations, two descriptors are often used, L_{dn} and L_{EQ}. The day-night average sound level (L_{DN} or DNL) is the average A-weighted sound level during a 24-hour period with 10 decibels added to nighttime levels (between 10:00 p.m. and 7:00 a.m.). This adjustment is added to account for the fact that human sensitivity increases during the nighttime hours when people are involved in more noise-sensitive activities (e.g., sleeping). The equivalent continuous sound pressure level (L_{EQ}) is a sound level that, if maintained continuously during a specific time period, would contain the same total energy as sound that varied over that time. Statistical values of noise levels are also frequently used to describe time-varying characteristics of environmental noise measured in A-weighted decibel scale. The L_{eq} values typically used are L_{10}, L_{50}, and L_{90}, representing noise levels that are exceeded at 10, 50, and 90 percent of the time, respectively. L_{10} represents a sound level considered intrusive, L_{50} is the median noise level, and L_{90} corresponds to background noise.

Noise effects on humans fall into three categories:

- Subjective effects such as annoyance, nuisance, and dissatisfaction;
- Interference with activities such as speech, sleep, and learning; and
- Physiological effects such as anxiety, tinnitus, or hearing loss.

Determining if a noise is objectionable depends on the type of noise (tonal, broadband, low frequency, or impulsive), in addition to the circumstance and individual sensitivity of the person who hears it. Typically, the levels associated with environmental noise only produce effects in the first two categories. However, workers subjected to noise in environments such as industrial plants or airports may experience noise effects similar to those described under the third category. Table 3-43, Subjective Response to Changes in Sound Level, illustrates how differences in sound magnitudes are perceived by humans.

Table 3-43
Subjective Response to Changes in Sound Level

Change in Sound Level	Perceived Change in Loudness
±1 decibel	Requires close attention to noise
±3 decibels	Barely perceptible
±5 decibels	Quite noticeable
±10 decibels	Dramatic; sounds nearly twice or half as loud
±20 decibels	Striking; fourfold change in loudness

Source: Berendt, Corliss, and Ojalvo 2000

3.20.2 Background Noise Levels

Background noise is the noise from all other sources than the source of interest (e.g., geothermal operations). The background noise level can vary considerably depending on the location. There is currently no available information defining existing noise levels in areas of geothermal potential on public and NFS lands, which would be recorded as background noise levels at any given project site. Natural background noises expected to exist in such areas include agricultural activities, recreation activities (including mechanized and motorized uses), oil and gas development, and aircraft over flights.

3.20.3 Noise Propagation

Predicting the noise level at a receptor location depends on a complex combination of source characteristics and site-specific factors (Anderson and Kurze 1992) that include:

- Source characteristics such as sound power, directivity, and configuration;
- Geometric spreading (geometric divergence) as the sound moves away from the source to the receptor;
- Atmospheric air absorption, which depends strongly on the sound frequency and relative humidity, less strongly on temperature, and slightly on pressure;
- Ground effects due to sound reflected by ground surfaces interfering with the sound propagating directly from the source to the receptor;

- The topography, structures, and other natural or human-made barriers between the source and the receptor; and
- Meteorological factors such as turbulence and variations in vertical wind speed and temperature.

Most screening applications only consider geometric spreading when predicting noise levels. A detailed analysis of noise levels would require a sound propagation model that integrates most of the sound attenuation mechanisms identified above; however, this type of analysis would require detailed source characteristics and site-specific data (e.g., as vegetation types, topography, and meteorological data). Moreover, the effects of variables such as vertical wind and temperature gradients can also have considerable impacts on such an analysis.

At short distances (less than 160 feet), the wind has a minor effect on the sound level. For locations at greater distances from a given source, wind can cause considerable differences in sound levels. Wind speed typically increases with height, and this variation focuses it in the downwind direction and creates a shadow in the upwind direction. Therefore, upwind sound levels will be lower, and downwind levels higher, than if there were no wind.

Changes in temperature with height also play a major role in sound propagation. During the day, air temperature decreases with height. In contrast, on a clear night, the temperature often increases with height (a condition known as a temperature inversion). The speed of sound varies with temperature so that generally sound bends (refract) upward during the day, leading to reduced sound levels on the ground, and bends downward during inversions, leading to higher sound levels on the ground. Such temperature effects are uniform in all directions, differing from those of wind that affect mostly upwind and downwind direction.

3.20.4 Noise Standards and Guidelines

The federal law that directly affects noise control is the Noise Control Act of 1972, as amended by the Quiet Communities Act of 1978 (42 USC 4901-4918). This Act delegates to the states the authority to regulate environmental noise. It also directs government agencies to comply with local community noise statutes and regulations, and to conduct their programs to promote an environment free of any noise that could jeopardize public health or welfare. More specifically, BLM regulations mandate that noise at one-half mile—or at the lease boundary, if closer—from a major geothermal operation shall not exceed 65 A-weighted decibels (43 CFR 3200.4[b]).

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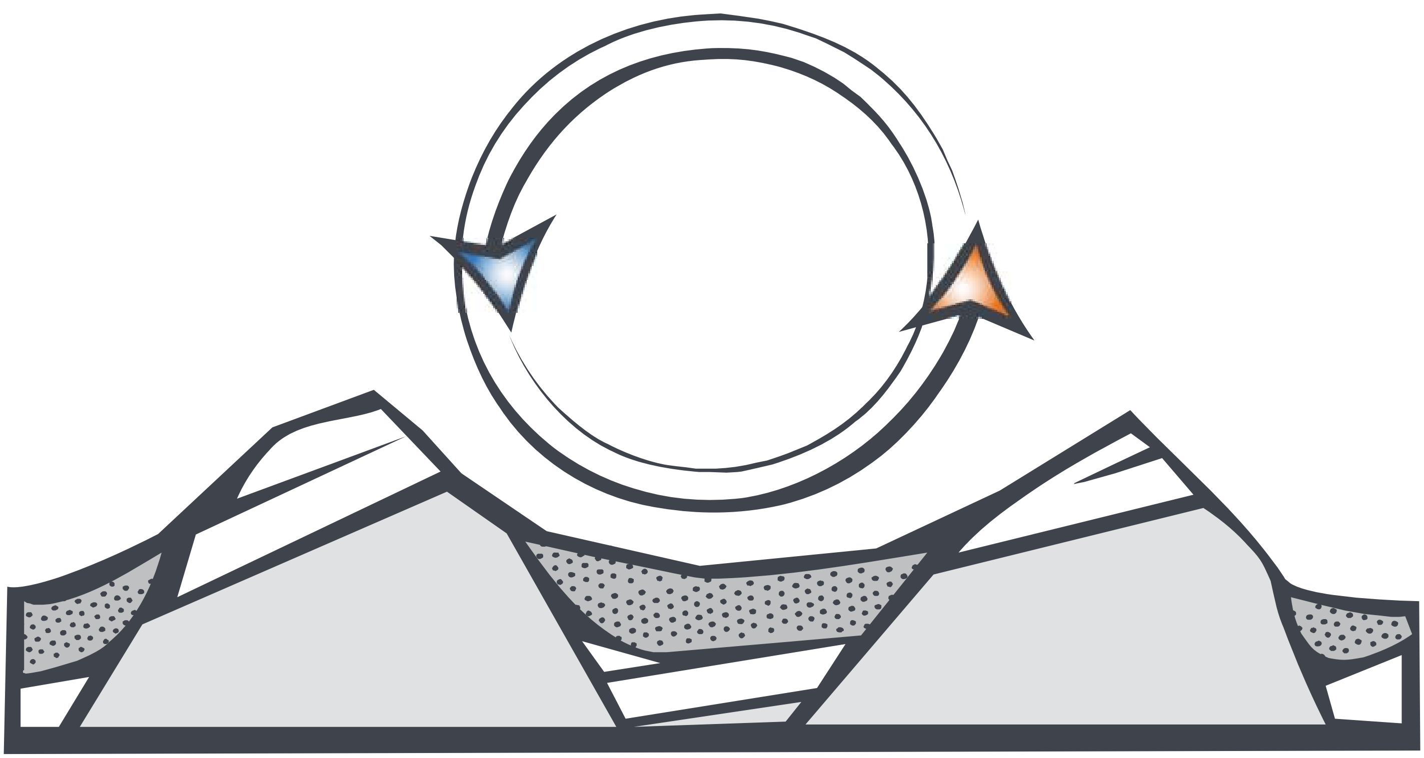

Chapter 4

Environmental Consequences

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CHAPTER 4
ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

This chapter analyzes the environmental consequences of impacts expected to occur as a result of implementing any future actions (including but not limited to any decisions to lease and/or develop geothermal resources) that may be taken consistent with the three alternatives: Alternative A (the No Action Alternative), Alternative B (the Proposed Action), and Alternative C (leasing within 10 miles from the centerline of existing transmission lines and 15 miles outside of the Yellowstone National Park boundary). The scope of the analysis is commensurate with the detail of the alternatives and the availability of data, and is at a programmatic level as discussed in Section 1.9 – Scope of Analysis. Current conditions of the planning area, as described in Chapter 3, provide the baseline for assessing impacts.

4.1.1 Methods of Impact Analysis

Issuance of a geothermal lease has no direct impacts on the environment; however, it is a commitment of the resource for potential future exploration, drilling operations and development, utilization, and reclamation and abandonment, subject to environmental review and permits. Therefore, an analysis is provided of the potential impacts of these various stages that may follow a leasing decision along with the potential cumulative impacts throughout the entire planning area.

The methodology for the following impact assessment conforms to the guidance found in the following sections of the CEQ regulations for implementing NEPA: 40 CFR 1502.24 (Methodology and Scientific Accuracy); 40 CFR 1508.7 (Cumulative Impact); and 40 CFR 1508.8 (Effects). CEQ regulations require that agencies "rigorously explore and objectively evaluate" the impact of all alternatives. Since the action alternatives presented in this PEIS propose allocating public and NFS lands as open or closed to geothermal leasing and amending land use plans, none of which has any effects as explained below, rather than project level exploration, development, and utilization of the resource, the focus of this analysis is on the impacts of these stages, which may follow leasing.

The Proposed Action and alternatives do not specifically propose development of a geothermal resource. For this reason, the analysis relies on the RFDs, which projects future geothermal leasing and development on public and NFS lands within the western US over the next 20 years based on best professional judgment. The RFD scenario assumes all lands are available for leasing, and therefore, does not consider any allocations (lands open or closed to geothermal leasing) prescribed under any of the alternatives. Its purpose is to demonstrate the level of expected development and show where the potential development might occur. It is important to note that the magnitude and extent of impacts on any resource or resource use will vary depending on the amount of land apportioned for each lease. A lease can range in size from 640 acres up to 5,120 acres.

Allocating lands and amending land use plans, in and of itself, does not cause any direct impacts as defined by the CEQ regulations, which state that such effects "are caused by the action and occur at the same time and place" (40 CFR 1508.8(a)). Prior to any ground disturbance or other future actions that would occur consistent with implementing the plan, further decision making would be required. This decision making must take place prior to future actions and involves consideration of a wide variety of factors, including, but not limited to, policy initiatives about timing of actions, whether any applications are submitted, whether funding is available, and compliance with other authorities and policies.

Similarly, lease issuance itself does not cause direct effects. The regulations governing geothermal leasing and development provide for several decision stages prior to any ground-disturbing activities taking place and may include further compliance with applicable authorities during these decision stages. Under this regulatory scheme, until BLM receives and adjudicates an application for a permit to drill or other authorization that includes specific information about a particular project, impacts of actual development that might follow lease issuance are speculative, as so much is unknown as to location, scope, scale, and timing of that development. At each decision stage, the BLM retains the authority to approve, deny, or approve subject to conditions any permit, based on compliance with applicable authorities and policies. Therefore, the analysis of effects of development in this Final PEIS reflects a more general, programmatic approach.

Any future development of geothermal resources, if and when it does take place, would result in effects. It is reasonable, therefore, to foresee that on-the-ground impacts would occur if the BLM issues geothermal leases. Those impacts would not occur, however, until some point in the future and following several decision stages. The following analysis, therefore, focuses primarily on both direct and indirect impacts of future development of geothermal resources based on the foreseeable on-the-ground actions, taking into consideration the stipulations, BMPs, and procedures outlined in Chapter 2. These impacts cannot be analyzed site-specifically, but they can be analyzed in general terms for the leasing area based on the RFD scenario.

Consideration of the effects of future actions that might occur under the alternatives described in this chapter also takes into account the phenomena of greenhouse gas (GHG) emissions, carbon sequestration, and climate change generally. The tools necessary to quantify climatic impacts are presently unavailable (US Geological Survey 2008). As a consequence, impact assessment of specific effects of anthropogenic activities and specific levels of significance cannot be determined. Therefore, climate change analysis for the purpose of this document is limited to accounting for and disclosing GHG emissions (and other factors that contribute to climate change) that may result from future activities that may be taken to implement the plan amendments proposed and analyzed in this document. Qualitative and quantitative evaluations of potential factors that may result from the future actions that may be taken to implement each alternative within the Planning Area are included, where appropriate and practicable.

Some of the GHGs associated with geothermal exploration and development will be naturally sequestered, while the balance of those emissions will accumulate with GHG concentrations in the atmosphere. This, in turn, is believed to contribute to further manifestations of climate change. However, since geothermal energy is a renewable energy with low carbon output compared with nonrenewable sources that currently dominate the US energy landscape, the development of geothermal energy projects can result in a net decrease in GHG emissions if the energy supplied to the grid allows fossil fuel-based power production, and its related GHG emissions, to be reduced.

While the GHG emissions of future actions that may be taken under each of the alternatives analyzed in this chapter can be estimated, current science does not permit quantification (or in some cases, even articulation) of the relationship between these emissions and the phenomena associated with global climate change. That is, while the relationship appears on a global level, it is not possible to make the connections between GHG emissions and global climate change on a local or even regional level (US Geological Survey 2008).

It is projected that the Alternative A *status quo* approach to land use allocation and leasing would result in the least amount of geothermal development, the least amount of new, clean energy being brought online, and the least potential for reducing GHG emissions. It is expected that projects developed consistent with Alternative B would result in the greatest amount of geothermal development, the greatest amount of new, clean energy being brought online, and the greatest potential for reducing GHG emissions. Projects developed consistent with Alternative C are expected to result in amounts of new, clean energy coming online and potential reductions in GHGs that are somewhere in between Alternatives A and B. As such, as much as a relationship can be drawn between GHG emissions and climate change, it is expected that the approach reflected in Alternative A would have the least beneficial impact on climate change and that the approach reflected in Alternative B would have the greatest beneficial impact on climate change.

Alternative C was developed such that projects would occur closer to existing transmission lines, meaning that on average, projects developed consistent with Alternative C would generally have less of a construction footprint (when considering transmission line length) and theoretically lower GHG emissions during the development phase. Therefore, while the approach to development reflected in Alternative B is expected to result in the greatest overall potential for reduction in GHG emissions, each project developed consistent with Alternative C may result in the greatest potential for GHG emissions on a *per project* basis.

4.1.2 Organization of Chapter 4

Because it is not possible to identify specific impacts from the decision to approve a geothermal lease or designate federal lands as open or closed to geothermal leasing, the evaluation of environmental resources has focused on those resources most likely to be affected during future geothermal development activities. Therefore, this chapter provides a programmatic presentation of common impacts from indirect and direct geothermal development by analyzing the RFD scenario and assessing potential impacts during the four sequential phases of geothermal development: (1) exploration, (2) drilling operations, (3) utilization, and (4) reclamation and abandonment. The discussion of impacts from geothermal development activities is general in nature and would occur regardless of the alternative.

Following the discussion of impacts associated with the RFDs and common impacts associated with each phase of geothermal resource development, a programmatic analysis illustrates the nature and magnitude of the impact to the resource that would be associated with any anticipated future action taken consistent with each of the respective alternatives.

4.2 LAND USE, RECREATION, AND SPECIAL DESIGNATIONS

4.2.1 What did the Public Say about Impacts on Land Use?

Comments received during the scoping period requested that development of geothermal energy on federal lands be executed in a manner compatible with other multiple use resource values and with BLM and FS management objectives. Comments also requested the use of standard best management practices to ensure minimal fragmentation of ecosystems and an analysis of additional road and transmission line construction. Industry comments recommended the analysis of impacts from exploration practices.

4.2.2 How Were the Potential Effects of Geothermal Leasing on Land Use Evaluated?

The geothermal planning area encompasses the 12 western states, including Alaska. Under Alternative A, the no action alternative, no geothermal leasing areas would be identified. All BLM- and FS-managed lands would be open to geothermal leasing unless closed in accordance with existing land use plans or congressional designation. Under Alternative B, approximately 197,225,000 acres are identified as open to geothermal leasing (118,000,000 acres of public land and 79,000,000 acres of NFS land), narrowing the scope of analysis down from approximately 243 million acres of federal lands in the planning area. Under Alternative C, fewer indirect use lands (approximately 61,200,000 indirect use acres on public land and 37,900,000 acres on NFS lands) would be open to geothermal leasing, further narrowing the scope of the analysis.

Potential impacts on land use could occur if reasonably foreseeable future actions were to:

- Conflict with management goals and objectives set forth by the BLM or FS in order to sustain the health, productivity, and diversity of these federal lands; or
- Result in proposed uses that are incompatible with existing or adjacent land uses.

4.2.3 What are the Common Impacts to Land Use Associated with Geothermal Development?

Due to the inability to predict future development scenarios, including types of development, timing, and location, the following impact analysis provides a general description of common impacts on land use from geothermal resource development. Issuing geothermal leases would not create any surface disturbances, and current activities on federal lands could continue as long as they did not interfere with the rights of the geothermal lessee. On lands where geothermal development is likely to occur, current uses include recreation, mining, hunting, energy development, communication sites, and right-of-way corridors.

The Reasonable Foreseeable Development Scenario for Land Use

According to the RFD scenario, it is estimated that 111 power plants could be constructed by 2015, and another 133 power plants could be constructed by 2025. The greatest development is expected to occur in California and Nevada, with the least development occurring in Arizona, Colorado, Wyoming, and Montana. The typical acreage of disturbance in a geothermal resource development phase is 53 to 367 acres. Therefore, total land use disturbance would be approximately 5,883 acres to 40,737 acres by 2015 and 12,932 acres to 89,548 acres by 2025.

BLM and FS manage approximately 676,000,000 acres in the western US, so these estimates would account for less than one percent of the total lands managed by both the BLM and FS.

Exploration

The exploration phase includes surveying and drilling temperature gradient wells. Surveying activities would impact land uses if additional roads or routes are developed to survey the potential geothermal sites. Additional roads could improve motorized and non-motorized access to previously inaccessible areas, impacting activities such as grazing and recreation. The magnitude and extent of the impact would depend on the current land use in the area. Following surveying activities, all roads and routes would be reclaimed to BLM and FS standards, thereby minimizing any long-term impacts on land uses.

Impacts on land uses from drilling temperature gradient wells would be short term and minor. Similar to surveying activities, roads would be required to access wells. Impacts from creating additional roads would be similar to those impacts described above. Several wells could be drilled per lease, and each drill site could disturb approximately 0.9 acres. Impacts would occur on lands directly under the well sites; drilling well sites may involve some leveling or grading, but impacts are primarily limited to the duration of the drilling and reclamation activities (several weeks). The drilling sites and access routes would be reclaimed to BLM and FS standards, thereby minimizing any long-term impacts on land uses.

Drilling Operations

The drilling operations phase would require production wells, injection wells, fluid sump pits, and new access roads to accommodate larger equipment. This development would impact any land use activity that is displaced as a result of the new roads and would affect land use activities that are sensitive to increases in motorized traffic (e.g., grazing).

The drilling operations phase also includes drill site development, which on average requires a 5-50 acre well pad per plant. Land under the well pad would be impacted, eliminating all other potential uses of the 5-50 acres site while the well pad is in operation.

Utilization

Geothermal utilization would result in long-term impacts on land use. Any land use activity such as grazing, recreation, hunting, mining, and other energy development activity would be impacted if the land was converted for geothermal use, displacing current activities and uses from these lands.

The utilization phase would require additional access roads for accessing the power plant and supporting well field equipment. The well field equipment consists of pipelines that vary from 24 to 36 inches in diameter. Where feasible, pipelines would parallel access roads and existing roads, minimizing the impacts on land uses. Pipelines are constructed with above-ground supports, which would minimize surface disturbance, but could affect any land use activity occurring above the ground. A power plant requires approximately 15 to 25 acres to accommodate all the needed equipment. Similar to other construction required during this phase, this would result in a direct loss of land use, displacing any current activities and uses from these lands. Installing electrical transmission lines from the power plant would disturb approximately one acre per mile of transmission line. Short-term minor impacts on land uses would occur during the installation of the powerlines; however, long-term impacts from wooden poles on land use would be minimal to negligible depending on existing land uses.

Impacts on land uses during operations within the utilization phase of geothermal resource development would be minimal. Short-term minor impacts would occur from standard operation and maintenance activities such as maneuvering construction and maintenance equipment and vehicles associated with these activities. No additional impacts would be recognized during this phase unless an additional drill site is required. Impacts from additional drill sites would be the same as those discussed under the exploration and drilling operations phases, above.

Reclamation and Abandonment

Reclamation and abandonment activities include abandoning the well after production ceases and reclaiming all disturbed areas. All disturbed lands would be reclaimed in accordance with BLM and FS standards, and land uses and activities could resume.

4.2.4 What are the Potential Impacts to Land Use Associated with the Proposed Action and Alternatives?

The following discussion analyzes the environmental consequences or impacts expected to occur as a result of anticipated future actions consistent with implementing the alternatives described in Chapter 2.

Impacts under Alternative A

Under the no action alternative, geothermal leasing for direct and indirect use would continue to occur on a case-by-case basis. Areas closed to geothermal leasing by statute, regulation, or orders would remain closed, and discretionary closed areas would be assessed based on local land use plans. The number of acres likely to be affected under this alternative is unknown.

Issuing geothermal leases on a case-by-base basis is not expected to affect land use. However, issuing a geothermal lease is an inherent commitment of the resource, and it is anticipated that impacts on land use would occur during geothermal exploration, drilling operations, and utilization phases, subject to environmental reviews and permits. In the absence of designating geothermal potential areas as open or closed, individual sites could be located in a number of locations and each would result in various long- and short-term impacts on land uses. Under this alternative, no comprehensive list of stipulations, best management practices, or procedures would be distributed to serve as a consistent guidance for future geothermal leasing and development. This would result in fragmented and segregated planning for land uses, which could increase recognized environmental impacts. Due to the uncertainty of total acreage considered for geothermal leasing and development under this alternative, it is not possible to quantify the total acreage affected on Federal lands.

Impacts under Alternative B

Under Alternative B, geothermal leasing for direct and indirect use would be open on approximately 197,225,000 acres. In the 12 western US states, this accounts for 54 percent of public and NFS lands (53 percent of public lands and 57 percent of NFS lands). Lands identified as open to geothermal leasing for direct and indirect use could be open with possible moderate to major constraints, depending on environmental conditions identified during site-specific reviews conducted by field offices and ranger districts prior to issuing the leases. Approximately 25,150,000 acres of public lands and 24,370,000 acres of NFS lands would be closed to geothermal leasing for direct and indirect use because these lands were found to be incompatible with geothermal leasing, exploration, and development. Areas identified as incompatible to geothermal leasing for direct and indirect use (Section 2.2.1, Allocating Lands for Leasing) include, but are not limited to, congressional designations (e.g., Wilderness Areas, National Conservation Areas) and administrative designations (e.g., Areas of Critical Environmental Concern and Inventoried Roadless Areas). Under this alternative, the BLM and FS would issue a comprehensive list of stipulations, best management practices, and procedures to serve as consistent guidance for future geothermal leasing for direct and indirect use. Relevant stipulations (Section 2.2.2) designed to protect existing land uses include controlled surface use in areas that have the potential for adverse impacts on residential areas, schools, or other adjacent urban land uses. In addition, in accordance with the identified BMPs (Appendix D), BLM and operators would contact appropriate agencies, property owners, and other stakeholders early in the planning process to identify potentially sensitive land uses and issues. It is expected that these measures would effectively avoid or minimize impacts on land uses by identifying conflicts early in the process and requiring specific measures to maintain public uses and values.

Impacts under Alternative C

Under Alternative C, geothermal leasing for indirect use would be open on 99,073,000 acres. All federal lands identified as open for indirect use under this alternative are within 10 miles of the centerline of existing transmission lines. Restricting the placement of indirect use geothermal resource development to nearby existing transmission lines would minimize impacts on land uses by concentrating land uses associated with energy development into designated areas.

Areas open to direct use geothermal lease applications and impacts from their anticipated subsequent development would be the same as identified under Alternative B.

4.2.5 What did the Public Say about Impacts on Special Designations?

Comments received during scoping requested that geothermal leasing and projects be prohibited in and adjacent to special designation areas. Requests were also made for examination of direct and indirect impacts on special designation areas.

4.2.6 How Were the Potential Effects of Geothermal Development on Special Designations Evaluated?

Potential effects of geothermal development on special designations were evaluated by analyzing all Congressionally designated areas in the planning area, in addition to examining all areas identified by the BLM and FS in land use plans as special administrative designation areas. Impacts on these areas resulting from any future actions taken consistent with each alternative were then considered and described.

Potential impacts on special designations could occur if reasonably foreseeable future actions were to:

- Conflict with management goals and objectives set forth by the BLM or FS in order to categorize, protect, and manage special designation areas;
- Conflict with conservation goals for the area; or
- Result in proposed land uses that are incompatible with existing or adjacent special designation areas.

4.2.7 What are the Common Impacts on Special Designations Associated with Geothermal Development?

Due to the inability to predict future development scenarios, including types of development, timing, and location, the following impact analysis provides a general description of common impacts on special designations from geothermal resource development.

The Reasonable Foreseeable Development Scenario for Special Designations

According to the RFD scenario, it is estimated that 111 power plants could be constructed by 2015, and another 133 power plants could be constructed by 2025. The greatest development is expected to occur in California and Nevada, with the least occurring in Arizona, Colorado, Wyoming, and Montana. Most congressionally designated areas in the planning area are withdrawn from leasing; therefore, it is anticipated that no reasonable foreseeable development activities would occur in these areas. Geothermal leasing is not precluded from administrative designations, however, and any activities that would affect the values and resources identified for protection under these designations would be prohibited. As such, it is anticipated that both impacts on special designations from reasonable foreseeable development activities would be negligible.

Exploration

Congressionally-designated areas are typically withdrawn from geothermal development, so no impacts on congressional designations are anticipated from geothermal exploration. Administrative designations are not automatically withdrawn from geothermal development; however, activities likely to affect the resources and values identified for protection under these designations would be precluded.

If exploration was permitted in either type of designation, prior to any activity occurring resources and values identified for protection under the designation would be analyzed for potential impacts. Activities affecting resources and values identified for protection in these areas would be prohibited. The effects of geothermal exploration on special designations are expected to be negligible.

Drilling Operations

Impacts on congressional and administrative designations during geothermal drilling operations would be similar to those described above under exploration. Drilling operations are not expected to occur in special designations. If drilling is permitted in either type of designation, prior to any activity occurring resources and values identified for protection under the designation would be analyzed for potential impacts. Activities affecting resources and values identified for protection in these areas would be prohibited. The effects of geothermal drilling operations on special designations are expected to be negligible.

Utilization

Impacts on congressional and administrative designations during geothermal utilization would be similar to those described above under exploration. Since geothermal development is not expected to occur in special designations, utilization is not anticipated. If geothermal development is permitted in either type of designation, prior to any activity occurring, resources and values identified for protection under the designation would be analyzed for potential impacts. Utilization activities affecting resources and values identified for protection in these areas would be prohibited. The effects of utilization on special designations are expected to be negligible.

Reclamation and Abandonment

Impacts on congressional and administrative designations during geothermal reclamation and abandonment would be similar to those described above under exploration. Since geothermal development is not expected to occur in special designations, reclamation and abandonment activities are not anticipated. If geothermal development is permitted in either type of designation, prior to any reclamation and abandonment activity occurring resources and values identified for protection under the designation would be analyzed for potential impacts. Reclamation and abandonment activities affecting resources and values identified for protection in these areas would be prohibited. The effects of reclamation and abandonment on special designations are expected to be negligible.

4.2.8 What are the Proposed Impacts on Special Designations Associated with Geothermal Development?

The following discussion analyzes the environmental consequences or impacts expected to occur as a result of anticipated future actions consistent with implementing the alternatives described in Chapter 2.

Impacts under Alternative A

Under Alternative A, geothermal leasing for direct and indirect use would continue to occur on a case-by-case basis, which has historically occurred at a very slow pace. Most congressionally designated areas in the planning area are withdrawn from geothermal leasing; therefore, it is anticipated that impacts on congressional designations would be negligible. In administrative designations, where geothermal leasing for direct and indirect use is not automatically precluded, field offices and ranger districts would determine if geothermal leasing would be in conformance with the prescriptions outlined in the relevant land use plan(s).

If geothermal leasing for direct and indirect use was permitted in either type of designation, prior to any activity occurring resources and values identified for protection under the designation would be analyzed for potential impacts. Activities affecting resources and values identified for protection in these areas would be prohibited, resulting in negligible impacts on special designations.

Impacts under Alternative B

Under Alternative B, the proposed action, the BLM and FS would designate a geothermal potential area (approximately 530 million acres) allocating all public and NFS lands in this area as open or closed to geothermal leasing for direct and indirect use. Congressional and administrative designations in this area that are incompatible with geothermal leasing, exploration, and development activities would be closed. As a result, approximately 25,150,000 acres of public lands and 24,370,000 acres of NFS lands would be designated as closed, excluding these areas from future geothermal leasing for direct and indirect use. As identified in Section 2.2.1 Allocate Lands for Leasing, congressional designations that would likely be closed include Wilderness Areas, National Conservation Areas, and National Monuments. Types of administrative designation closures could include Wilderness Study Areas and some Areas of Critical Environmental Concern. Appendices I and J provide a list of congressional and administrative designations and associated acreages[1].

The following are exceptions for areas closed to geothermal leasing for direct and indirect use:

Congressional Designations

- California Desert Conservation Area (25 million acres, of which half is BLM-administered public lands) would remain open to geothermal leasing. The California Desert Conservation Area establishes long-term goals for protection and use of the California Desert. However, public lands within the designation fall under one of four multiple-use classes. Management in these classes ranges from Class C (Controlled), where lands are managed for preservation and protection, to Class I (Intensive Use), where lands are managed for concentrated use to meet human needs (grazing, mining, energy, and utility development). Over 1.67 million acres are considered to have potential for geothermal resources within the California Desert Conservation Area, however, the multiple-use class would determine whether leasing would be permitted and to what extent.

Administrative Designations

- On either public or NFS lands, if the prescription for an administrative designation, as described in the applicable land use plan(s), allows for geothermal leasing, then at the discretion of the field office or range district, these areas could remain open to geothermal leasing.
- On NFS lands, an Inventoried Roadless Area designation would not prohibit geothermal leasing; however, a nondiscretionary restriction would be placed on any leases within the designation. As a result, these areas generally may not contain geothermal development due

[1] The sum of acres for special designations (as identified in **Appendices I and J**) does ***not*** equal total acres closed to geothermal leasing under this alternative. Federal land parcels may contain more than one special designation, so adding the acreages for each designation would result in double counting.

to restrictions on road construction and reconstruction. This stipulation would cover about 80,596,000 acres.

Under this alternative, the BLM and FS would issue a comprehensive list of stipulations, best management practices, and procedures to serve as consistent guidance for future geothermal leasing for direct and indirect use. Relevant stipulations (Section 2.2.2) designed to protect special designated areas include (1) no surface occupancy on designated and eligible river segments for wild and scenic river status, and on designated or eligible sites for the National Register of Historic Places; and (2) controlled surface use for protection of National Landmarks and National Register Districts. Under the proposed leasing procedures (Section 2.2.2), other special management areas would be evaluated prior to leases using existing land use plans and environmental documentation. In addition, in accordance with BMPs (Appendix D), BLM and operators would contact appropriate agencies, property owners, and other stakeholders early in the planning process to identify potentially sensitive land uses and issues. It is expected that these measures would effectively avoid or minimize impacts to special designated areas by requiring protection and/or maintenance of the relevant and important characteristics and values of these areas.

Impacts under Alternative C

Under Alternative C, impacts on special designations from indirect use geothermal development would be similar to those described under Alternative B; however, under this alternative the geothermal potential area for indirect use is limited to areas located within 10 miles of the centerline of existing transmission lines and 15 miles from of the Yellowstone National Park boundary. The indirect use geothermal potential area would be 99,073,000 acres, which is a 50 percent decrease from Alternative B. Similar to Alternative B, the list of areas closed to geothermal leasing for indirect use under this alternative include congressional and administrative designations that are incompatible with geothermal leasing, exploration, and development activities within 10 miles of the centerline of existing transmission lines, in addition to all areas outside of the transmission line buffer. As a result, approximately 81,950,000 acres of public lands and approximately 65,710,000 acres of NFS lands would be closed to indirect use leasing.

Areas open to direct use geothermal lease applications and impacts from their subsequent development would be the same as identified under Alternative B.

4.2.9 What did the Public Say about Impacts on Recreation?

Comments received during the scoping period requested that impacts on outdoor recreation and consequences for non-mechanized, mechanized, and motorized recreation be studied and discussed. Commentors also asked that recreational impacts from the development of land tracts and their subsequent uses be analyzed.

4.2.10 How Were the Potential Effects of Geothermal Development on Recreation Evaluated?

This section examines the typical short- and long-term impacts on recreation areas and activities from geothermal development. Potential impacts on recreation could occur if reasonably foreseeable future actions were to:

- Conflict with existing recreational uses of the area; or
- Diminish existing recreational benefits and opportunities by altering the recreational setting or activity that is allowed in an area.

4.2.11 What are the Common Impacts on Recreation Associated with Geothermal Development?

Due to the inability to predict future development scenarios, including types of development, timing, and location, the following impact analysis provides a general description of common impacts on recreation from geothermal resource development. Since issuing geothermal leases would not create surface disturbances, current recreation activities could continue until site-specific geothermal operations begin.

The Reasonable Foreseeable Development Scenario for Recreation

According to the RFD scenario, it is estimated that 111 power plants could be constructed by 2015, and another 133 power plants could be constructed by 2025. The greatest development is expected to occur in California and Nevada. The BLM and FS combined manage approximately 1,500 recreation areas, with the greatest percentage of recreation areas located in California (23 percent). Recreation users in designated areas, as well as dispersed recreation users, would be affected by geothermal development. The development of geothermal resources would alter the physical, social, and operational character of the recreation setting, thereby altering an individual's experiences.

Exploration

Surveying and drilling activities that occur during the exploration phase of geothermal development would result in the physical restriction of recreation areas, temporarily reducing the amount of land available for recreational use and accessible trails. This would displace some recreation users and limit recreation activities. Exploration activities would be completed in one to five years, at which time recreation activities could resume.

During exploration activities, recreation users participating in activities near sites would realize a diminished recreation experience. Recreation users could experience an increase in noise, vibration, and dust. Additionally, exploration could shift the ROS setting, by varying degrees, towards an urban setting to capture the addition of visual impacts such as wells, rigs, support equipment, water trucks and other vehicles, and backhoes that would become part of the landscape.

New access roads required for exploration could increase public access to previously inaccessible areas, thereby increasing recreational opportunities for some users. However, this would also alter the experience for people seeking a more remote experience in those same areas.

Drilling Operations

The drilling operations phase would result in long-term impacts on recreation resources. Similar to effects described above under the exploration phase, drilling operations could also shift the ROS setting, by varying degrees, towards a more urban setting.

Impacts on recreation resources from new access roads required for drilling operations would be similar to those impacts described above under the exploration phase.

Utilization

Impacts on recreation resources during the utilization phase of geothermal resource development would be similar to those discussed above under the drilling operations phase. The conversion of recreation lands for geothermal utilization would displace recreation users and limit activities in some areas. People engaged in activities such as hiking, camping, birding, and hunting would be most affected by construction activities within the utilization phase. During operations within the utilization phase, recreation resources would experience short-term minor impacts from standard operation and maintenance activities such as maneuvering construction and maintenance equipment and vehicles associated with these activities, which may interfere with traffic flow of recreational visitors.

Reclamation and Abandonment

Reclamation and abandonment activities include abandoning the well after production ceases and reclaiming all disturbed areas. Increased traffic from reclamation and abandonment activities could affect timely public access as described above under the utilization phase. All disturbed lands would be reclaimed in accordance with BLM and FS standards, and recreation activities could resume, improving recreational opportunities.

4.2.12 What are the Proposed Impacts on Recreation Associated with Geothermal Development?

The following discussion analyzes the environmental consequences or impacts expected to occur as a result of anticipated future actions consistent with implementing the alternatives described in Chapter 2.

Impacts under Alternative A

Under the no action alternative, geothermal leasing for direct and indirect use would continue to occur on a case-by-case basis. The number of acres likely to be affected under this alternative is unknown; however, it is anticipated that minimal changes would occur in intensity to current recreational uses due to the historically slow pace of issuing geothermal leases on federal lands.

In the absence of designating geothermal potential areas as open or closed, individual sites could be developed in a number of locations and each would result in various long-term and short-term impacts on recreation activities. Under this alternative, no comprehensive list of stipulations, best management practices, or procedures would be distributed to serve as a consistent guidance for future geothermal leasing and development for direct and indirect use. This would result in fragmented and segregated planning for recreational uses, which could increase conflicts among recreation users and increase environmental impacts.

Impacts under Alternative B

Under Alternative B, the proposed action, BLM and FS would identify all public and NFS lands as open or closed to direct and indirect use within the geothermal planning area (530 million acres). Under this alternative, all designated recreation areas (Table 3-5) and lands containing dispersed recreation opportunities would be open to geothermal leasing (direct and indirect use). This includes all public lands allocated as either a Special Recreation Management Area (SRMA) or an Extensive Recreation Management Area (ERMA). National Recreation Areas, managed by BLM and FS, however are congressional designations and would be closed to geothermal leasing for direct and indirect use. (Please refer to Section 2.2.1 for complete listing of lands designated as closed to geothermal leasing.)

The action of designating lands, coupled with issuing geothermal leases, would not create any surface disturbances and therefore would not impact recreation resources. However, issuing a geothermal lease for direct or indirect use is an inherent commitment of the resource for potential future exploration, drilling, utilization, reclamation, and abandonment, subject to environmental review and permits; therefore, it is anticipated that impacts on recreation resources would occur during the geothermal exploration, drilling operations, and utilization phases.

Once geothermal development for direct or indirect use begins under this alternative, there would be minor to moderate impacts on recreation resources. As described in Section 4.1.11, What are the Common Impacts Associated with Geothermal Leasing and Development, recreation activities could be disrupted through the physical restriction of recreational areas and user trails.

Throughout various phases of geothermal development, users' enjoyment of the area could also be impacted by noise, vibration, dust, and visual impacts. Impacts on recreation resources would occur until the reclamation and abandonment phase, at which time recreation activities could resume.

In areas where SRMA boundaries overlay open geothermal potential areas, recreation users would likely be displaced to other areas. Activities related to geothermal development would alter the recreational setting within these areas, hindering the capability of the settings to continue to produce the desired existing recreation opportunities and facilitate the recreation experience and benefit opportunities. Opportunities for visitors to the SRMA would be impacted.

Under this alternative, the BLM and FS would issue a comprehensive list of stipulations, best management practices, and procedures to serve as consistent guidance for future geothermal leasing for direct and indirect use. Relevant stipulations (Section 2.2.2) designed to minimize conflicts with recreation include (1) no surface occupancy on developed recreational facilities, special-use permit recreation sites, and areas with significant recreational use with which geothermal development is deemed incompatible (excluding direct use applications), and for designated important viewsheds; and (2) controlled surface use in areas that have the potential for adverse impacts to recreational values (both motorized and non-motorized) and the natural setting associated with the recreational activity. In addition, in accordance with BMPs (Appendix D), BLM and operators would contact appropriate agencies, property owners, and other stakeholders early in the planning process to identify potentially sensitive recreational areas and issues.

It is expected that these measures would effectively avoid or minimize impacts to recreation and recreational areas by protecting the most significant recreation resources, maintaining recreational opportunities and recreational experience, reducing user and resource conflicts, and in some instances improving recreational opportunities (i.e., allowing access via new roads, etc.).

Impacts under Alternative C

Impacts from anticipated future actions consistent with implementation of Alternative C related to indirect use would be similar to those impacts described under Alternative B; impact intensity would vary depending on the percentage of recreation areas and lands identified for dispersed recreation uses that fall within 10-miles of the centerline of existing transmission lines. Stipulations and BMPs would be applied with similar effects as under Alternative B.

Areas open to direct use geothermal lease applications and impacts from their anticipated subsequent development would be the same as identified under Alternative B.

4.3 GEOLOGIC RESOURCES AND SEISMIC SETTINGS

4.3.1 What did the Public Say about Impacts on Geologic Resources and Seismic Setting?

The public was especially concerned with protecting and preserving the resources of Yellowstone Park. Commentors offered the following suggestions to protect these resources:

- Avoiding any geothermal feature or system hydraulically liked to Yellowstone's aquifer;
- Banning geothermal resource development within 15 miles of the park;
- Expanding the protected area to include the Island Park Geothermal Area and the areas defined in the Yellowstone Compact; and
- Banning development on federal land and on private lands with federal mineral rights within the area when not absolutely sure there would be no impact to the geothermal resources within the park.

Other comments were received on the effects of geothermal fluid withdrawal (e.g., subsidence) and injection (e.g., increasing seismic activity, triggering volcanic eruptions at Yellowstone Park).

4.3.2 How Were the Potential Effects of Geothermal Development on Geologic Resources and Seismic Setting Evaluated?

The potential effects of geothermal development were evaluated by assessing the effects that anticipated future actions consistent with the alternatives would have on the geology and unique geologic resources of the project area. Geothermal leasing itself would have no direct impacts on geologic resources. Indirect impacts could occur from subsequent development activities, including large-scale surface disturbances such as mining, erosion, diversion of the heat and energy resulting in reduction of surface thermal features, off-road vehicles, excavation, and vandalism; damage and vandalism are usually concentrated near roads and trails.

Specific geologic features may have value to paleontological, scenic, recreational, or cultural resources, and impacts on these resources are discussed in their respective sections. In this section, impacts to geologic features are evaluated only from the perspective of scientific value. Effects are quantified where possible; in the absence of quantitative data, best professional judgment was used.

Seismic risk is more likely to impact geothermal facilities than operation of geothermal facilities is to increase seismic risk. The high pressure injection of fluids directly into faults zones has been related to increases in seismic activity in some cases. However, the high pressure injection of fluids from outside the geologic system is not the same as where geothermal fluid withdrawn from the resources is used and then reinjected back into the system for a near zero net change. The near zero net change would represent much lower risk of increasing seismic activity.

Subsidence can occur where groundwater is pumped from underground aquifers at a rate exceeding the rate that it is replenished. Most of the geothermal development includes reinjection of the geothermal fluid after the heat is utilized. Therefore, the potential for subsidence is low.

4.3.3 What are the Common Impacts on Geologic Resources and Seismic Setting Associated with Geothermal Development?

Large-scale unique geologic features (e.g., the Yellowstone area, Grand Canyon) are protected through units of the national park and national monument systems. Smaller-scale unique geologic features (e.g., natural arches, caves, sources of unique geologic specimens) that are outside the park and monument systems could be impacted by geothermal resource development activities.

The potential impacts on geologic resources from geothermal development mainly concern physical disturbance (e.g., movement, removal or destruction). These impacts are considered long term, as they cannot be reclaimed. In most BLM resource management plans, and in FS policy, leasing and associated roads and other physical disturbance must avoid sensitive geologic resources in order to be approved. Additional indirect impacts would result from greater public access to formerly inaccessible areas. Greater public access can result in increased wear and vandalism of sensitive geologic features. These impacts can be short term if roads are reclaimed.

Due to the inability to predict future development scenarios, including types of development, timing, and location, the following impact analysis provides a general description of common impacts on geologic resources from geothermal resource development. The RFD scenario for geothermal resource use involves four sequential phases: exploration, drilling operations, utilization, and reclamation and abandonment.

The Reasonable Foreseeable Development Scenario for Geologic Resources and Seismic Setting

According to the RFD scenario, it is estimated that 111 power plants could be constructed by 2015, and another 133 power plants could be constructed by 2025. The most development is expected to occur in California and Nevada, and the least is expected to occur in Arizona, Colorado, Wyoming, and Montana. The typical acreage of disturbance in a complete buildout for geothermal resource development is 53 to 367 acres. Therefore, total land use disturbance would be approximately 5,883 acres to 40,737 acres by 2015 and 12,932 acres to 89,548 acres by 2025.

Exploration

The exploration phase includes surveying and drilling temperature gradient wells. Surveying activities would directly impact geologic resources through disturbance at seismic survey pulse sites. Detonation of explosives would greatly disturb a small area around each detonation. Any delicate geologic resources (e.g., natural arches, balancing rocks, cave formations) within the blast area would be disturbed. The use of thumper trucks would not impact sensitive geologic resources. While the area of disturbance at each seismic pulse site would be small, a large seismic survey could include many sites. New roads or routes may be needed to allow survey equipment to access the potential geothermal sites. Roads would disturb any geologic resources within the right-of-way. The impacts of surveying activities would be short term.

The impacts to geologic resources from drilling temperature gradient wells would be minor. The siting of the wells would not likely impact geologic resources, as clear flat areas are preferable for drilling sites. Similar to surveying activities, roads would be required to access wells, which would impact any geologic resources within the right-of-way. Several wells could be drilled per lease, and each drill site could disturb approximately 0.9 acres. Impacts would occur on lands directly under the well sites.

By following BLM and FS guidelines, sensitive geologic resources would be avoided. The long-term impacts would be minor. The impacts of increased public access due to new road construction would be short term, as the roads allowing the increased public access would be reclaimed after exploration activities are complete.

Drilling Operations

The drilling operations phase would result in long-term impacts to any geologic resources within the area of disturbance. The drilling operations phase would require additional access roads to accommodate larger equipment to drill production and injection wells and to construct sump pits. Roads to accommodate production wells are typically between 0.5 and 4 miles long and 30 feet wide, for a disturbance of between 2 and 15 acres. The drilling operations phase includes drill site development, which on average requires a 5-50 acre disturbance from well pads.

Spent or used geothermal fluids may be reinjected back into the geothermal resource, evaporated in sumps or lagoons, or used for potable and nonpotable domestic and municipal uses depending on the water quality of the geothermal fluid, shallow groundwater quality, and surface water conditions. If the proposed geothermal resource development includes high-pressure reinjection, there is a small chance that seismic activity could increase along any faults intersected by the injection well.

Any geologic resource within the areas of disturbance described above would be impacted. These impacts would be long term, as they could not be reclaimed. Impacts resulting from increased public access would also be long term for the life of the development.

Utilization

Impacts on geologic resources during initial buildout of the utilization phase of geothermal resource development would be greater than the other phases of development because of the increased footprint. The utilization phase requires construction of additional roads, wells, and structures to support full buildout of a direct use or indirect use facility. The utilization phase would require access roads to accommodate larger equipment, plus additional roads for accessing the power plant. The well field equipment includes pipelines with a disturbance zone approximately 40 feet wide. Where feasible, pipelines would parallel access roads and existing roads. The disturbance would include the pads for pipeline supports as well as the access and maintenance roads along the pipeline.

A power plant requires approximately 15 to 25 acres to accommodate all the needed equipment. Similar to other construction required during this phase, this would result in a direct disturbance of any geologic resources within the footprint of the facility. Installing electrical transmission lines from the power plant would disturb approximately one acre per mile of transmission line for lengths from 5 to 50 miles. The disturbance would include the pads for powerline support structures as well as the access and maintenance roads along the powerline.

The initial areas disturbed during construction of the utilization phase would continue to be used sporadically during standard operation and maintenance activities, such as maneuvering construction and maintenance equipment and the vehicles associated with these activities. No additional impacts would be recognized during this phase unless an additional drill site is required. Impacts from additional drill sites would be the same as discussed under the drilling operations phase, above.

Reclamation and Abandonment

Reclamation and abandonment activities include abandoning the wells after production ceases and reclaiming all disturbed areas. All disturbed lands would be reclaimed in accordance with BLM and FS standards. If the roads are reclaimed, the impacts resulting from greater public access would decrease.

4.3.4 What are the Potential Impacts on Geologic Resources and Seismic Setting Associated with the Proposed Action and Alternatives?

The following discussion analyzes the environmental consequences or impacts expected to occur as a result of anticipated future actions consistent with implementing the alternatives described in Chapter 2.

Impacts under Alternative A

Under the no action alternative, lease applications would continue to be processed on a case-by-case basis. Areas closed to geothermal leasing by statute, regulation, or orders would remain closed, and discretionary closed areas would be assessed based on local land use plans. The number of acres likely to be affected under this alternative is unknown.

Issuing geothermal leases for direct and indirect use on a case-by-base basis includes avoiding potential impacts from anticipated future actions on unique geologic resources in many BLM field offices and FS ranger districts. In addition, unique geologic resources may receive protection through avoidance and mitigation measures for other resources, where those resources include unique geologic features. Examples include features that are part of a Class I visual landscape, features of cultural importance to Native Americans, or caves with bat populations.

Under this alternative, no comprehensive list of stipulations, best management practices, or procedures would be distributed to serve as consistent guidance for future geothermal leasing and development. The leasing approvals and stipulations would continue to be varied, as would mitigation and reclamation levels. Overall potential impacts to geologic resources from anticipated future actions would be similar to those identified in the four phases of development in Section 4.3.3, above, on a case-by-case basis.

Impacts under Alternative B

Under Alternative B, the Island Park Geothermal Area would be closed to direct and indirect geothermal resource development. The BLM or FS would apply lease stipulations (Section 2.2.2) to protect the integrity of geothermal resource features, such as springs and geysers, in areas open to geothermal resource development. The BLM or FS would include lease stipulations to protect any significant thermal features of a National Park System unit that could be adversely affected by geothermal development. In addition, any leases that contain thermal features (e.g., springs or surface expressions) would have a stipulation requiring monitoring of the thermal features during any exploration, development, and production of the lease to ensure that there are no impacts to water quality or quantity. Unique geologic resources in areas open to geothermal leasing and development for direct and indirect use would also be protected through avoidance and mitigation measures for other resources, where those resources include unique geologic features (e.g., visual and cultural resources). Alternative B includes many comprehensive closures, stipulations, and BMPs (Appendix D) affecting these other resources that would result in more protection for associated unique geologic features than under Alternative A. It is expected that these measures would effectively avoid or minimize impacts to geologic resources and seismic settings by protecting the most sensitive areas and monitoring for and maintaining the unique resource values of all other geologic features.

Impacts under Alternative C

Alternative C focuses geothermal leasing and development for indirect use on public lands and NFS lands that are within 10 miles of the centerline of existing transmission lines and at least 15 miles outside of the Yellowstone National Park boundary. The public and NFS lands outside of these areas would be closed to indirect use leasing.

The comprehensive list of stipulations, best management practices, and procedures discussed under Alternative B would be applied to those areas open for direct and indirect use under Alternative C. Potential impacts from anticipated future actions within the transmission line area are expected to be minimal because of the previous disturbance to geologic resources during construction of the existing transmission lines. Areas open to direct use geothermal lease applications and impacts from their anticipated subsequent development would be the same as identified under Alternative B.

4.4 ENERGY AND MINERAL RESOURCES

4.4.1 What did the Public Say about Impacts on Energy and Minerals?

Public comments included whether to close particular types of public lands (e.g., National Parks, FS roadless areas) to geothermal development, consideration of existing and proposed transmission line routes, discussion of other power sales agreements in the proposed development areas, and the past reclamation of subsurface minerals and energy resource claims in the area.

The discussion of other power sales agreements in the proposed development areas is outside the scope of this PEIS. The presence of and plans for other power generation or transmission facilities near the proposed development sites are evaluated as part of the cumulative impacts analysis (Chapter 5).

The track record of past reclamation activities is outside the scope of this PEIS. The status and condition of past reclamation efforts for other energy and mineral resource developments was included in the affected environment discussion for the various environmental resources in each specific leasing area. The conditions associated with reclamation of the subject geothermal developments are included in the discussions for each environmental resource.

4.4.2 How Were the Potential Effects of Geothermal Development on Energy and Minerals Evaluated?

The potential effects of geothermal development were evaluated by assessing the effects that anticipated future actions consistent with implementation of the alternatives described in Chapter 2 would have on energy and mineral resources. Geothermal leasing itself would have no direct impacts on energy and mineral resources. Impacts would occur from subsequent development activities.

Potential impacts on energy and mineral resources could occur if reasonably foreseeable future actions were to:

- Result in the construction of transmission lines that would affect the feasibility of other energy development along the transmission corridor; or
- Develop roads that would encourage other energy and mineral exploration in otherwise undeveloped areas.

4.4.3 What are the Common Impacts on Energy and Minerals Associated with Geothermal Development?

Developing energy and mineral resources on federal lands is subject to location and operational constraints resulting from national, regional, and local laws, regulations, policies, and guidelines associated with protecting other environmental resources (e.g., endangered species). These protections include withdrawing or closing lands to energy and mineral resource activities, exclusion areas, buffer zones around sensitive areas, limitations on surface occupancy, seasonal limitations, and other permit stipulations. Changes in these regulations and policies have the direct effect of increasing or decreasing the land available for energy and resource development and associated costs.

The impacts on energy and mineral resources from potential geothermal exploration and development activities would be greatly dependent on the local presence and characteristics of energy and mineral resources. Due to the inability to predict future development scenarios, including types of development, timing, and location, the following impact analysis provides a general description of common impacts on energy and mineral resources from geothermal resource development.

Common impacts from geothermal energy development include vegetation loss, air quality impacts from fugitive dust and diesel exhaust, noise emissions, soil erosion and compaction, and hazardous waste generation.

The Reasonable Foreseeable Development Scenario for Energy and Minerals

In general, any infrastructure improvements (e.g., roads, transmission lines, pipelines) associated with the exploration and development of geothermal resources would have a minor to major advantage for the exploration and development of other energy and mineral resources within the immediate area.

Any land being used for exploration and development activities would become unavailable for developing other mineral resources (e.g., aggregates, solid minerals).

Exploration

Improving existing roads and constructing new roads for geothermal resource exploration would have a negligible to minor impact on the exploration for other energy and mineral resources in the immediate area. The degree of impact would depend on the existing limits to access in the area and the distance of the roads to the other mineral resources.

Drilling Operations

The cost of improving roads would be less for later developments because roads accessing the general area will have already been developed. These impacts would be reduced with increased distance from the new roads. Drilling operations would preclude developing any other energy or mineral resources on the same land.

Utilization

Introducing new transmission lines would encourage developing other energy resources along the transmission line. Mineral resource developments would be encouraged due to the new availability of power for their operations. These impacts would be reduced with increased distance from the power plant, roads, and transmission lines.

During the utilization phase, other operations in the immediate area of the power plant might be able to take advantage of the downstream heat from the power plant. Utilization of the geothermal resources would have minor or no impact on other energy or mineral resources.

Reclamation and Abandonment

Upon reclamation and abandonment of geothermal operations, any other ongoing operations in the area would have to take over maintenance of shared facilities (e.g., roads, transmission lines). Reclamation and abandonment of geothermal resources would have minor or no impact on other energy or mineral resources.

4.4.4 What are the Potential Impacts on Energy and Minerals Associated with the Proposed Action and Alternatives?

The following discussion analyzes the environmental consequences or impacts expected to occur as a result of anticipated future actions consistent with implementing the alternatives described in Chapter 2.

Impacts under Alternative A

Under the no action alternative, lease applications would continue to be processed on a case-by-case basis. Areas closed to geothermal leasing by statute, regulation, or orders would remain closed, and discretionary closed areas would be assessed based on local land use plans. Geothermal resources are managed by BLM and FS as fluid leasable minerals, which includes oil and gas. Therefore, policies on closure of land to fluid minerals leasing or restrictions on the fluid minerals activities apply to both geothermal and oil and gas resources.

Some of the land classifications listed in Section 2.2.1 (e.g., ACECs, roadless areas) do not include automatic closure to fluid minerals leasing and therefore do not include closure to geothermal leasing for direct or indirect use. Other lands have exclusion or buffer zones (e.g., National Historic Trails) that vary from field office to field office based on local conditions. Where these constraints vary, they are applied or expanded at the discretion of the individual field offices. No surface occupancy/no ground disturbance constraints and other mitigation and reclamation requirements are applied on a case-by-case basis and are often dependent on site-specific conditions. The number of acres likely to be affected under this alternative is unknown.

Impacts under Alternative B

Under Alternative B, the amount of land closed to geothermal leasing for direct and indirect use would increase compared to Alternative A. Some lands currently open, or open with stipulations, to fluid minerals leasing would be closed to geothermal leasing for direct and indirect use. Buffer zones around other features would increase as they are applied to geothermal resource leasing for direct and indirect use. These restrictions would be applied uniformly throughout the western states.

Under Alternative B, the stipulations listed in Section 2.2.2 and the BMPs listed in Appendix D would be required, with exceptions granted on a case-by-case basis. Under Alternative A, stipulations and BMPS are applied only on a case-by-case basis, as there are no consistent guidelines across field offices.

There would be less land available for exploration and development of geothermal resources for direct and indirect use under Alternative B when compared to Alternative A. The increased restrictions would result in increased operational costs.

These increased constraints would not apply to fluid minerals leasing other than geothermal resources (e.g., oil and gas leasing) or to other energy developments (e.g., solar and wind). The amount of land available to other fluid minerals leasing would not change. Those constraints that are applied on a case-by-case basis at the discretion of the field offices would not be changed to general restrictions.

There would be no immediate impact on the availability of lands for exploration and development of other energy and fluid mineral resources under Alternative B. There would be no associated increase in operational costs. However, there is potential that these additional closures and higher levels of restrictions would establish new precedents and would subsequently affect the policies and practices guiding all energy resource development and fluid minerals leasing on federal lands. Should this occur, the amount of land available to other energy resource development and fluid minerals leasing would decrease to the same degree as geothermal leasing. The increased restrictions would increase the associated operational costs.

Impacts under Alternative C

Under Alternative C, only those lands within 10 miles of the centerline of existing transmission lines and at least 15 miles outside of the Yellowstone National Park boundary would be available for indirect use geothermal resource development. The standardized stipulations and constraints discussed under Alternative B would be applied to these lands. The lands outside of the existing transmission line buffer would be closed to indirect use geothermal development.

There would be less land available for exploration and development of geothermal resources for indirect use than under Alternatives A or B. The increased restrictions would result in increased operational costs within the existing transmission line buffer.

These increased constraints would not apply to other energy resource development and fluid minerals leasing other than geothermal resources (e.g., oil and gas leasing). The amount of land available to other energy resource development and fluid minerals leasing would not change. There would be no associated increase in operational costs.

Areas open to direct use geothermal lease applications and impacts from their subsequent development would be the same as identified under Alternative B.

4.5 PALEONTOLOGICAL RESOURCES

4.5.1 What did the Public Say about Impacts on Paleontological Resources?

No comments pertaining to impacts on paleontological resources were received.

4.5.2 How Were the Potential Effects of Geothermal Development on Paleontological Resources Evaluated?

The loss of any fossil that could yield information important to prehistory, or that embodies the distinctive characteristics of a type of organism, environment, period of time, or geographic region, would be an impact on paleontological resources. Paleontological resource impacts primarily concern the potential destruction of nonrenewable fossil resources and the loss of information associated with these resources. This includes destruction as the result of surface disturbance and the unlawful or unauthorized collection of fossil remains.

Paleontological resources are preserved in sedimentary geologic units of Precambrian to Pleistocene age. Geothermal resources are, by nature, located in tectonically active areas with topographic and structural complexities that are typically characterized by extensive formational exposures that may include fossiliferous rocks. The potential for impacts on both surface and subsurface paleontological resources is directly proportional to the amount of surface disturbance associated with a proposed action. At this programmatic level of analysis, it is not possible to identify and evaluate areas of higher paleontological sensitivity with respect to locations of proposed surface disturbance. Therefore, potential impacts on paleontological resources under each alternative can only be generally estimated, and they correlate directly to the amount of anticipated surface disturbance proposed under each alternative.

To the extent possible at this level of analysis, potential impacts on paleontological resources were evaluated using the recently revised Potential Fossil Yield Classification system (PFYC, BLM 2008-009). This evaluation of potential effects on paleontological resources assumes that geothermal leasing alternatives associated with the largest acreage of disturbance correlate with the greatest likelihood of impacts on paleontologically sensitive (PFYC Class 3-5) geologic formations. This assumption may prove to be inaccurate once lease-specific analyses are undertaken, but it is appropriate for a programmatic level of analysis.

Potential impacts on paleontological resources could occur if reasonably foreseeable future actions were to result in the following:

- Result in the disturbance of paleontologically sensitive geologic formations (PFYC Class 3-5); or

- Conflict with paleontological resource management objectives and guidelines established by the BLM and FS.

4.5.3 What are the Common Impacts on Paleontological Resources Associated with Geothermal Development?

Due to the inability to predict future development scenarios, including types of development, timing, and location, the following impact analysis provides a general description of common impacts on paleontological resources from geothermal resource development.

Impacts on nonrenewable surface or subsurface paleontological resources result from destruction by breakage and crushing during surface-disturbing actions. Surface disturbance related to geothermal development has the potential to impact an unknown quantity of fossils that may occur on or underneath the surface in areas containing paleontologically sensitive geologic units. Without mitigation, these fossils, as well as the paleontological data they could provide if properly salvaged and documented, could be destroyed, rendering them permanently unavailable. Impacts can typically be mitigated to below a level of significance by implementing paleontological mitigation. Mitigation also results in the salvage of fossils that may never have been unearthed as the result of natural processes. With mitigation, these newly exposed fossils become available for scientific research, education, display, and preservation into perpetuity at a public museum.

Impacts also result from the continuing implementation of management decisions and associated activities. For paleontological resources, impacts most commonly occur as the result of management actions that increase the accessibility of public lands, increasing the potential for loss of paleontological resources by vandalism and unlawful collecting (poaching). These impacts are difficult to mitigate to below the level of significance, but they can be greatly reduced by increasing public awareness about the scientific importance of paleontological resources through education, community partnerships, and interpretive displays, and by informing the public about penalties for unlawful destruction or unlawful collection of these resources from public lands.

Cumulative impacts result from individually minor but collectively significant actions taking place over a period of time. In general, if previously unrecorded, scientifically significant paleontological resources are present within the Planning Area, the potential cumulative impacts would be low, so long as mitigation was implemented to salvage the resources. The use of stipulations, best management practices, and paleontological resources management plans as described under Alternative B in this section would effectively recover the value to science and society of significant fossils that would otherwise have been destroyed by ground-disturbing actions.

Because paleontological resources are nonrenewable, impacts that result in their loss are considered to be long term.

The Reasonable Foreseeable Development Scenario for Paleontological Resources

The four RFD phases of geothermal development include exploration, development, production, and closeout. According to the RFD scenario, it is estimated that 111 power plants could be constructed by 2015, and another 133 power plants could be constructed by 2025. The greatest development is expected to occur in California and Nevada, with the least occurring in Arizona, Colorado, Wyoming, and Montana. The typical acreage of disturbance in a geothermal resource development phase is 53 to 367 acres. Therefore, total geothermal surface disturbance would be approximately 5,883 acres to 40,737 acres by 2015 and 12,932 acres to 89,548 acres by 2025.

Exploration

Geothermal exploration is anticipated to last from one to five years and involves first surveying and then drilling for temperature gradient wells. Surface disturbance resulting from geothermal surveys is primarily the result of access road construction and seismic and resistivity surveys. Drilling for temperature gradient wells results in surface disturbance during construction of wells and access roads.

Impacts on surface and subsurface paleontological resources could occur wherever grading for access roads and drilling sites takes place in paleontologically sensitive geographic areas or geologic units. Seismic and resistivity surveys have the potential to impact surface occurrences of paleontological resources where these activities take place in paleontologically sensitive areas/geologic units. Additional impacts could occur as the result of increased public access to previously remote paleontologically sensitive areas.

Drilling Operations

This phase requires grading for additional access roads, developing drill sites (average of two acres per well pad), and constructing pipelines, additional wells (production and injection), and sump pits.

As previously stated, impacts on surface and subsurface paleontological resources could occur wherever surface-disturbing actions related to geothermal development take place in paleontologically sensitive geographic areas or geologic units. Additional impacts could occur as the result of increased public access to previously remote paleontologically sensitive areas.

Utilization

Construction within the drilling operations phase involves assembling the infrastructure needed to use the underground geothermal reservoir and would last from two to ten years. Construction within the drilling operations phase involves the greatest amount of surface disturbance and therefore has the greatest potential for impacting paleontological resources. This phase requires grading for access roads, developing drill sites (average of 5-50 acre well-pad disturbance per plant), and constructing pipelines, transmission lines, and power plants (approximately 15 to 25 acres per plant site).

Operations within the utilization phase lasts from ten to thirty years and involves the ongoing operation and maintenance of the geothermal field, including developing new drilling sites, as needed.

Reclamation and Abandonment

Reclamation and abandonment activities include reclamation of all disturbed areas after production ceases. Assuming that no new surface disturbance occurs during the closeout phase, no new impacts on surface or subsurface paleontological resources would be anticipated.

Following the reclamation and abandonment phase, paleontologically sensitive areas that are reclaimed and that become less accessible to the public would lower the future likelihood of loss through vandalism and unlawful collection, thus lowering future impacts associated with these activities to pre-geothermal leasing levels.

4.5.4 What are the Potential Impacts on Paleontological Resources Associated with the Proposed Action and Alternatives?

The following discussion analyzes the environmental consequences or impacts expected to occur as a result of implementing the alternatives described in Chapter 2.

Impacts under Alternative A

Under the no action alternative, areas closed to geothermal leasing by statute, regulation, or orders would remain closed, and discretionary closed areas would be assessed based on local land use plans. The number of acres likely to be affected under this alternative is unknown.

Due to the uncertainty of the total acreage and specific locations considered for geothermal leasing and development for direct and indirect use under this alternative, it is not possible to quantify the total acreage of potentially affected paleontologically sensitive formations. However, issuing geothermal leases on a case-by-base basis is not expected to result in different effects on paleontological resources than Alternatives B and C. In the long term, if case-by-case leasing for direct and indirect use results in a larger cumulative geographic area of surface disturbance than Alternatives B and C, then Alternative A may have a greater likelihood of impacts on paleontological resources using the assumptions made in Section 4.5.2.

Impacts under Alternative B

Under Alternative B, the proposed action, approximately 118,000,000 acres of public land and 79,000,000 acres of FS land would be designated as open to geothermal leasing for direct and indirect use.

As stated above, due to the uncertainty of total acreage and specific locations considered for geothermal leasing and development for direct and indirect use under Alternative A, it is not possible to quantifiably compare the potential for paleontological resource impacts between anticipated future actions consistent with each of the alternatives. However, due to the Alternative C proposal that indirect use geothermal leasing be further restricted to within a 10-mile distance of the centerline of existing transmission lines, Alternative B has a higher likelihood of anticipated future actions with impacts on paleontological resources than Alternative C using the assumptions made in Section 4.5.2.

Under this alternative, the BLM and FS would issue a comprehensive list of stipulations, best management practices, and procedures to serve as consistent guidance for future geothermal leasing for direct and indirect use. In accordance with BMPs (Appendix D), operators would determine whether paleontological resources exist in a project area on the basis of the sedimentary context of the area, a records search of past paleontological finds in the area and/or, depending on the extent of existing information, paleontological survey. If paleontological resources are present at the site, or if areas with high potential have been identified, a paleontological resources management plan would be developed that identifies appropriate monitoring and protection measures. Unexpected discovery of paleontological resources during geothermal development would be brought to the attention of the responsible BLM authorized office immediately and work would be halted in the vicinity of the finds to avoid further disturbance while the finds are evaluated and appropriate mitigation measures are developed. It is expected that these measures would effectively avoid, minimize or mitigate impacts on paleontological resources by protecting and conserving significant paleontological resources as they are discovered on public lands.

Impacts under Alternative C

Under Alternative C, approximately 61,200,000 acres of public land and 37,900,000 acres of NFS land would be designated as open to geothermal leasing for indirect use. Alternative C differs from Alternative B in that the BLM and FS would only consider indirect use leasing within 10 miles from the centerline of existing 60 kV to 500 kV transmission lines.

Due to the uncertainty of the total acreage and specific locations considered for geothermal leasing and development for direct and indirect use under Alternative A, it is not possible to quantifiably compare the potential for paleontological resource impacts from anticipated future actions consistent with Alternative A and those anticipated future actions consistent with Alternatives B and C, respectively. However, due to the Alternative C proposal that geothermal leasing for indirect use be further restricted to within 10 miles from the centerline of existing transmission lines and at least 15 miles outside of the Yellowstone National Park boundary, Alternative C has a lower likelihood of anticipated future actions with potential impacts on paleontological resources than Alternative B using the assumptions made in Section 4.5.2. Impacts within the transmission line area are expected to be minimal because of the previous disturbance to paleontological resources while constructing the existing transmission lines.

Areas open to direct use geothermal lease applications and impacts from anticipated future actions consistent with Alternative C would be the same as identified under Alternative B.

4.6 SOIL RESOURCES

4.6.1 What did the Public Say about Impacts on Soil Resources?

Commentors requested that direct and cumulative impacts on steep, unstable, easily eroded, and saline soils be assessed. Other commentors requested that the analysis include spill prevention, planning, and cleanup measures for geothermal resource development activities.

4.6.2 How Were the Potential Effects of Geothermal Development on Soil Resources Evaluated?

Chapter 3 discussed the types of soil resources (orders) and their general characteristics present in the areas with potential for geothermal development. Impacts on soil resources are discussed in generic terms of amount of disturbance typically associated with geothermal resource development. Impacts on specific soil types, including prime and unique farmlands and farmlands of statewide importance, are discussed for each proposed lease. The amount of disturbance that would be associated with the reasonably foreseeable development scenario was assessed for the soil resources present in each specific lease area.

Potential impacts on soil resources could occur if reasonably foreseeable future actions were to result in the following:

- Remove prime farmlands from production;
- Take place on slopes of greater than 40 percent;
- Increase the mid- to long-term erosion of soil resources in the area;
- Cause soil resource compaction where soil crusts are present; or
- Result in spills of hazardous materials.
- Remove forest land from production

The potential impacts of the alternatives were evaluated on the basis of amount of area that would be open for exploration and development and the general presence of soil crusts, easily eroded soils, and prime farmlands.

4.6.3 What are the Common Impacts on Soil Resources Associated with Geothermal Development?

The potential impacts on soil resources from geothermal development include physical disturbance (e.g., movement or removal), compaction, changes to erosion patterns, and changes in current use as farmland. Any development or infrastructure (e.g., wells, roads, or pipelines) on steep slopes would increase erosion and could increase risk of landslides.

Due to the inability to predict future development scenarios, including types of development, timing, and location, the following impact analysis provides a general description of common impacts on soil resources from geothermal resource development. This RFD scenario involves four sequential phases: exploration, drilling operations, utilization, and reclamation and abandonment.

The Reasonable Foreseeable Development Scenario for Soil Resources

According to the RFD scenario, it is estimated that 111 power plants could be constructed by 2015, and another 133 power plants could be constructed by 2025. The most development is expected to occur in California and Nevada and the least is expected to occur in Colorado, Arizona, Wyoming, and Montana. The typical acreage of disturbance in a complete geothermal resource development is 53 to 367 acres. Therefore, total land use disturbance would be approximately 5,883 acres to 40,737 acres by 2015 and 12,932 acres to 89,548 acres by 2025.

Exploration

The exploration phase includes surveying and drilling temperature gradient wells. Surveying activities would impact soil resources through disturbance at seismic survey pulse sites. Detonation of explosives would greatly disturb a small area around each detonation. The soil resources beneath each thumper truck site would be compacted. While the area of disturbance at each seismic pulse site would be small, a large seismic survey could include many sites. New roads or routes may be needed to allow survey equipment to access the potential geothermal sites. The impacts of survey activities would be short term. Following surveying activities, all roads and routes would be reclaimed to BLM and FS standards, thereby minimizing any long-term impacts on land uses.

The impacts on soil resources from drilling temperature gradient wells would be minor. Similar to surveying activities, roads would be required to access wells. Several wells could be drilled per lease, for an area of disturbance of approximately 0.9 acres. Impacts would occur on lands directly under the well sites; however, impacts last only the duration of the drilling and reclamation activities (several weeks). The drilling sites and access routes would be reclaimed to BLM and FS standards, thereby minimizing any long-term impacts on soil resources.

Drilling Operations

The drilling operations phase of development would result in short-term impacts on soil resources. The drilling operations phase would require access roads to accommodate larger equipment. Roads for the production wells are typically between 0.5 and 4 miles long and 30 feet wide, for a disturbance of between 2 and 15 acres. New roads would impact any soil resources within their rights-of-way.

The drilling operations phase also includes drill site development, which on average requires a two-acre well pad. Soil resources under each well pad would be impacted.

Utilization

The utilization phase of development would result in long-term impacts on soil resources. The utilization phase would require additional access roads to accommodate larger equipment and for accessing the power plant. Well field equipment and support structures would be constructed. The well field equipment includes pipelines with a disturbance zone approximately 40 feet wide and typically one to four miles in length. Where feasible, pipelines would parallel access roads and existing roads, minimizing the impacts on soil resources. Pipelines are constructed on supports above ground, which would minimize surface disturbance. The disturbance would include the pads for pipeline supports and the access and maintenance roads along the pipeline.

A power plant requires approximately 15 to 25 acres to accommodate all the needed equipment. Similar to other construction required during this phase, this would result in a direct disturbance of the soils within the footprint of the facility.

Installing electrical transmission lines from the power plant would disturb approximately 24-240 acres with a 40-foot-wide disturbance area along transmission line for lengths from 5 to 50 miles long. The disturbance would include the pads for powerline support structures and the access and maintenance roads along the powerline.

Impacts on soil resources during the operation of the geothermal power plant would be minimal. The initial areas disturbed during construction would continue to be used sporadically during standard operation and maintenance activities, such as maneuvering construction and maintenance equipment and the vehicles associated with these activities. No additional impacts would be recognized during this phase unless an additional drill site is required. Impacts from additional drill sites would be the same as those impacts discussed under the exploration and drilling operations phases, above.

Reclamation and Abandonment

Reclamation and abandonment activities include abandoning the wells after production ceases and reclaiming all disturbed areas. All disturbed lands would be reclaimed in accordance with BLM and FS standards.

4.6.4 What are the Potential Impacts on Soil Resources Associated with the Proposed Action and Alternatives?

The following discussion analyzes the environmental consequences or impacts expected to occur as a result of implementing the alternatives described in Chapter 2.

Impacts under Alternative A

Under the no action alternative, lease applications would continue to be processed on a case-by-case basis. Areas closed to geothermal leasing by statute, regulation, or orders would remain closed, and discretionary closed areas would be assessed based on local land use plans. The number of acres likely to be affected under this alternative is unknown.

Issuing geothermal leases for direct and indirect use on a case-by-base basis is not expected to affect soil resources. Impacts on soil resources would occur during subsequent exploration, drilling operations, and utilization phases. These activities at each individual site would incur various long- and short-term impacts on soil resources. Under this alternative, no comprehensive list of stipulations, best management practices, or procedures would be distributed to serve as consistent guidance for future geothermal leasing and development. The leasing approvals and stipulations would continue to be varied, as would mitigation and reclamation levels.

While all disturbed lands would be required to be reclaimed in accordance with BLM and FS standards, these standards may be applied in a varied manner for individual field offices and ranger districts. Due to the uncertainty of total acreage considered for geothermal leasing and development for direct and indirect use under this alternative, it is not possible to quantify the total acreage affected on federal lands.

Impacts under Alternative B

Under Alternative B, the proposed action, geothermal leasing for direct and indirect use would be open on 118,000,000 acres of public lands and 79,000,000 acres of NFS lands in the western US and Alaska. Lands identified as open to geothermal leasing for direct and indirect use could include moderate to major constraints to reduce potential impacts on soil resources, depending on the environmental conditions identified during site-specific reviews conducted by field offices and ranger districts prior to issuing the leases. Approximately 25,150,000 acres of public lands and 24,370,000 acres of NFS lands would be closed to geothermal leasing for direct and indirect use because the lands are incompatible with geothermal leasing, exploration, and development. Additional lands could be closed to geothermal resource leasing for direct and indirect use due to local conditions at the discretion of the individual field offices and ranger districts.

Under this alternative, the BLM and FS would issue a comprehensive list of stipulations, best management practices, and procedures to serve as consistent guidance for future geothermal leasing for direct and indirect use. Relevant stipulations (Section 2.2.2) designed to minimize impacts on soil resources include 1) no surface occupancy on slopes in excess of 40 percent and/or soils with high erosion potential; and 2) controlled surface use on slopes greater that 30 percent and/or erosive soils as defined as severe or very severe erosions classes based on Natural Resources Conservation Service mapping. In accordance with BMPs (Appendix D), operators would identify unstable slopes and local factors that can induce slope instability. Special construction techniques would be used where applicable in areas of steep slopes, erodible soil, and stream channel crossings. Operators would also be required to adhere to a plan of development that includes spill prevention and cleanup provisions. It is expected that these measures would effectively avoid and/or minimize impacts on soil resources by protecting the most sensitive areas, minimizing erosion, maintaining soil productivity, and minimizing surface disturbance from authorized activities.

Impacts under Alternative C

Under Alternative C, geothermal leasing for indirect use would be open on 61,200,000 acres of public lands and on 37,900,000 acres of NFS land in the western US and Alaska. Geothermal resource development for indirect use would be encouraged within 10 miles of the centerline of existing transmission lines and at least 15 miles outside of the Yellowstone National Park boundary.

The comprehensive list of stipulations, best management practices, and procedures discussed under Alternative B would be applied to those areas within the transmission line buffer areas. Areas open to direct use geothermal lease applications and impacts from their subsequent development would be the same as identified under Alternative B.

4.7 WATER RESOURCES AND QUALITY

4.7.1 What did the Public Say about Impacts on Water Resources and Quality?

Commentors asked that the impacts on surface water resources from geothermal development activities be discussed in the PEIS, including changes to drainage in development areas, discharges, onsite containment, water additives, stormwater discharge permits, 404 permits and waters of the US in the development areas, and impacts on water hydrology and stream channel morphology, water quality, pools, and hot springs.

Commentors asked that the impacts on groundwater resources from geothermal development activities be discussed in the PEIS, including preventing the accidental discharge of geothermal fluids with toxic chemical properties into the environment, water needs for geothermal resource development, impacts on water quantity and quality, methods of water discharge, and differences with shallow groundwater.

4.7.2 How Were the Potential Effects of Geothermal Development on Water Resources and Quality Evaluated?

Leasing land does not involve ground-disturbing activities or any type of construction, so there would be no direct impact on water resources. Impacts would result from activities pursued after leasing.

This section discusses the potential impacts of anticipated future actions consistent with each of the alternatives on the water resources in the Planning Area. Potential impacts on water resources could occur if reasonably foreseeable future actions were to result in the following:

- Involved surface disturbance such as building roads or preparing drill sites or plant sites that could increase erosion and sedimentation;
- Substantially depleted groundwater supplies or interfered substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level;
- Uses or facilities that would substantially degrade surface or groundwater quality; or
- Changing conditions such that the geothermal resource itself was degraded.

Water quality and quantity is of interest to other resources as well. Biological resources, cultural resources, and recreation may be impacted by changes to water quantity and quality. In this section, impacts on water resources are evaluated only from the perspective of changes to water availability and quality.

Impacts from the perspective of other values (e.g., impacts of water quality on livestock, or reduced flow from a sacred spring) are discussed in sections for the other resources. Effects are quantified where possible; in the absence of quantitative data, best professional judgment was used. While the development of geothermal resources would be intricately linked with groundwater and surface water rights, those rights are very specific to individual locations, aquifers, landowners, and local jurisdictions.

4.7.3 What are the Common Impacts on Water Resources and Quality Associated with Geothermal Development?

Geothermal fluids can be steam or fluid or a mixture under pressure. The geothermal fluids are extracted from the resource, and the heat is used either directly to heat air or water or indirectly to generate electrical power. Once the heat in the geothermal fluid has been used, it is considered "spent." Direct-use systems are smaller and have less impact than indirect uses. Indirect uses are discussed below.

Direct-use geothermal systems use low- to moderate-temperature fluids. Binary power systems use higher temperature geothermal fluids or use heat exchangers with lower boiling point working fluids. The steam and flash steam power plants use the mixed geothermal fluids and pure steam.

The spent geothermal fluid is usually reinjected into the geothermal resource, but it may be evaporated in lagoons or discharged to surface water depending on the relative water quality and temperature. In rare cases, the spent geothermal fluid may be potable and used for agricultural or domestic purposes. The dry steam power plants emit the steam after it has been used and reinject any condensed fluids.

Developing geothermal resources includes using surface water or groundwater for operations, mostly as cooling water. The US Environmental Protection Agency estimates that each megawatt-hour of electricity generated from geothermal resources consumes approximately 200 to 300 gallons of water (US EPA 2008f). This water is primarily used for cooling the operating steam (used to turn turbines) back into a liquid state so that it can be reinjected into the geothermal reservoir. For a given amount of electricity generated, geothermal power plants require less cooling water than fuel combustion boilers and nuclear boilers for the following reasons:

- Geothermal power plants have lower steam temperatures and therefore require less water to bring the steam (used to turn turbines) back into a liquid state.
- Cooling water from geothermal power plants is injected into the geothermal reservoir at a much higher temperature than cooling water from fuel combustion and nuclear boilers, which is typically discharged

into surface water bodies that often support aquatic ecosystems. This additional cooling of water for power facilities discharging to natural surface water bodies is necessary to minimize impacts on the ecosystems supported by those water bodies. To achieve this additional cooling to temperatures that are usually only slightly above that of the receiving water, combustion- and nuclear-based power plants often use larger volumes of cooling water.

The amount of cooling for each geothermal plant depends on the temperature and type of geothermal fluids, the methods used to generate power, the throughput, and the type of cooling used. Air cooling uses very little water. Most binary power plants do not use any water.

The chemical and thermal properties of the geothermal fluid can pose potential threats to surface water and groundwater quality. Geothermal water can contain a variety of dissolved compounds, including silica, sulfates, carbonates, metals, and halides. Any mixing of geothermal fluids with surface or groundwater where the chemical and thermal qualities of the geothermal fluids would degrade the other water in the area would potentially damage aquatic ecosystems and contaminate drinking water supplies.

Due to the inability to predict future development scenarios, including types of development, timing, and location, the following impact analysis provides a general description of common impacts on water resources from geothermal resource development. The degree of impact would vary greatly depending on local conditions including presence of sole source aquifers, hot springs, and the existing water quality.

The Reasonable Foreseeable Development Scenario for Water Resources and Quality

In general, any ground disturbance activities associated with geothermal resource development (roads, transmission lines, pipelines) would have a minor to negligible impact on surface water and groundwater resources within the immediate area. However, if an area is already heavily impacted due to existing operations or conditions, even these minor impacts could be substantial.

Exploration

Survey activities would have little to no impact on surface or groundwater. Exploration drilling would involve some ground-disturbing activities such as road and drilling pad construction. This could lead to an increase in soil erosion, with the result that more soil might be transported in surface runoff. Best management practices (see Appendix D) to reduce sediment erosion and to prevent sediment from being transported to surface water areas would be implemented in compliance with stormwater pollution prevention requirements of the Clean Water Act. By following BLM and FS guidelines, impacts on water resources would be avoided. The long-term impacts would be minor. The short-term impacts would be moderate and mitigable.

Drilling Operations

Geothermal fluids in the resource can be under high pressures. Drilling can create pathways for these fluids into the groundwater at shallower depths or commingling between aquifers of differing quality. The impacts of these pathways can alter the natural circulation of the geothermal fluids and impact the usefulness of the resource. Subsurface pathways also can allow the natural contaminants in the geothermal fluids to impact the shallow groundwater quality if mixing were to occur. The degree of impact depends on aquifer characteristics and whether special conditions (e.g., sole source aquifers) are present. Proper drilling practices and closure and capping of the wells can reduce this potential.

During normal operations, liquid wastes from drilling activities are stored in lined sumps before being properly disposed of in accordance with state regulations. Geothermal fluid production and associated waste production is likely to occur for short periods as wells are tested to determine reservoir characteristics. If geothermal fluids are discovered in commercial quantities, development of the geothermal field is likely. During the initial stages of testing, one well is likely to be tested at a time. If testing is successful and the well and reservoir are sufficient for development, well heads, valves, and control equipment would be built on top of the well casing to prepare for the utilization phase.

Release of geothermal fluids during well testing can cause temporary impacts on surface waters within the immediate area of the test wells if not contained. These impacts include thermal changes and changes in water quality depending on the differences in the geothermal fluid and the surface waters. Accidental spills of geothermal waters may occur due to well blowouts during drilling, leaking piping or well heads, or overflow from sump pits.

BLM and FS guidelines and state regulations for maintaining and plugging and capping wells to prevent blowouts and mandating proper well casing and drilling techniques would minimize the risk of impacting surface water and groundwater in the immediate area.

Groundwater extraction and injection wells are installed and pumped to cycle geothermal fluids within the geothermal reservoir to remove heat energy. To be effective, it is desirable to create an efficient circulation system where the injected (cool) fluid is resident in the formation long enough to heat up to the maximum temperature without significantly altering subsurface pressures. This requires a highly permeable geothermal aquifer that is preferably isolated from any shallow cool water or potable water aquifer above it. High injection pressures can fracture rock, with resultant leakage of geothermal fluids.

Typically these fluids are highly mineralized, so geothermal production systems could contaminate shallow freshwater aquifers and heat could be lost to the surface.

Extracting geothermal fluids could result in drawdowns in connected shallower groundwater aquifers, with the resulting potential to affect streams or springs that are in turn connected to the water table aquifer. The potential for these types of adverse impacts is reduced through extensive aquifer testing, which is the basis for designing the geothermal plant and for locating, designing, and operating the extraction and injection wells. Combined with the requirement to comply with state and federal regulations that protect water quality and with limitations imposed by water rights issued by the state engineer, the impacts on water quality and the potential for depleting water resources is expected to be minimized. There is a medium risk for moderate to high impacts on groundwater supplies from the use of groundwater for geothermal activities.

Utilization

During construction, ground-disturbing activities such as road and foundation pad construction and utility installation could lead to an increase in soil erosion, with the result that more soil might be transported in surface runoff. Construction activities may also increase the risk of fire which could also result in increased erosion. Best management practices to reduce sediment erosion (see Appendix D) and to prevent sediment from being transported to surface water areas would be implemented in compliance with nonpoint (stormwater) pollution prevention requirements of the Clean Water Act.

Geothermal resource utilization could affect groundwater resources because of consumption of water by evaporation and the need to reinject water to replenish the geothermal reservoir. The magnitude of the effects would vary depending on groundwater conditions and availability within the basin and on the type of geothermal plant. Availability of water resources could be a limiting factor, affecting the expansion of geothermal resource development in a given area.

During normal operations and when production wells are tested, geothermal plants produce wastewater from cooling tower blowdown. This is the spent water that is periodically discharged from the cooling system. Makeup water is used to replace or make up for the evaporative losses and blowdown in a water-cooled system. The quantity of cooling tower blowdown depends on the size of the power plant, the quality of the makeup water (lower quality water requires more frequent cycling), the nature of the additives to prevent mineral scale, and the number of times the water is cycled. The source of cooling water could be either surface water or groundwater.

Production of geothermal fluids could be expected to vary from 1to 6 million gallons per day per well. Assuming 5 million gallons per day per well as an average production figure, a lease with two producing wells would produce 10 million gallons of fluid per day.

Once a plant is operational, most geothermal fluids produced are reinjected back into the geothermal reservoir via reinjection wells. In flash steam facilities, about 15 to 20 percent of the fluid would be lost due to flashing to steam and evaporation through cooling towers and ponds. Binary power plants are non-consumptive and use a closed loop system. Fluids could also be lost due to pipeline failures or surface discharge for monitoring and testing the geothermal reservoir. In dry steam facilities, where steam is the only geothermal fluid, very little of the steam can be cooled for reinjection.

The cooling water could be discharged either to the ground or to an evaporation pond. Discharging cooling tower blowdown or water from testing geothermal production wells could affect shallow groundwater quality if the discharged water percolated to a shallow aquifer. Discharging cooling tower blowdown water would be subject to a National Pollution Discharge Prevention System permit issued by the appropriate state oversight agency, which would require testing to ensure that the water met the discharge requirements and did not degrade groundwater quality. The state would likely require that the cooling water be discharged to a lined pond to prevent infiltration. Therefore, the potential for water quality impacts on surface water from operational discharges of a geothermal plant are expected to be minor or mitigable.

The original coolant water and the replenishment water contain salts that become concentrated in the cooling system over time, requiring that the coolant be periodically replaced. The cooling water may also contain metals or other constituents introduced from corroding pipes or from chemical additives used to inhibit corrosion or microbial growth in the system. Low-toxicity additives are available that could be used in the cooling towers to lower the potential for impacts from this source.

Air-cooled systems use less cooling water and are more common in arid regions. Air-cooled systems would have fewer impacts associated with cooling water.

During operations, geothermal fluids are kept as part of a closed loop until they are reinjected into the geothermal resource. However, small amounts of these contaminants can be accidentally released into the surface environment from venting steam to eliminate excessive pressure or through mechanical breakdowns like broken pipes. The temporary release of fluids from tests and accidents would have minor impacts on any surface waters in the immediate area.

Hot springs are surface features that indicate the presence of geothermal features deep within the earth. These springs can be part of sensitive ecosystems, recreation areas, or traditional cultural properties. The geothermal resources that would be developed are usually at greater depths than the shallow groundwater associated with the hot springs. However, withdrawing shallow groundwater or surface water for cooling water purposes could affect nearby springs.

Reclamation and Abandonment

The reclamation and abandonment phase would involve plugging and capping production and injection wells. Improper abandonment could allow the wells to serve as pathways for geothermal fluids to migrate to other aquifers, affecting both the geothermal resource and other groundwater quality. Proper well closure and capping would reduce the risk of these impacts.

4.7.4 What are the Potential Impacts on Water Resources and Quality Associated with the Proposed Action and Alternatives?

The following discussion analyzes the environmental consequences or impacts expected to occur as a result of implementing the alternatives described in Chapter 2.

Impacts under Alternative A

Under the no action alternative, lease applications would continue to be processed on a case-by-case basis. Areas closed to geothermal leasing by statute, regulation, or orders would remain closed, and discretionary closed areas would be assessed based on local land use plans. The restrictions and stipulations on geothermal exploration and development activities for direct and indirect use would also be determined by the individual field offices and ranger districts on a case-by-case basis. The number of acres likely to be affected under this alternative is unknown.

Issuing geothermal leases for direct and indirect use on a case-by-base basis includes avoiding impacts on water resources in many BLM field offices and FS ranger districts. In addition, water resources may be protected through avoidance and mitigation measures for other resources where those resources include water resources. Examples include wetlands, designated wild and scenic rivers, endangered species habitat, and springs of cultural importance to Native Americans.

Under this alternative, no comprehensive list of stipulations, best management practices, or procedures would be distributed to serve as consistent guidance for future geothermal leasing and development. The leasing approvals and stipulations would continue to be varied, as would mitigation and reclamation levels.

Impacts under Alternative B

Under Alternative B, Designated Wild Rivers under the Wild and Scenic River Act and The Island Park Geothermal Area (includes NFS lands in Idaho and Montana) would be closed to geothermal leasing for direct and indirect use.

Geothermal leasing for direct and indirect use would be open on 118,000,000 acres of public lands and on 79,000,000 acres of NFS land in the western US and Alaska. Lands identified as open for geothermal leasing for direct and indirect use could have moderate to major constraints related to potential impacts on water resources, depending on environmental conditions identified during site-specific reviews conducted by field offices and ranger districts prior to issuing the leases. Approximately 25,150,000 acres of public land and 24,370,000 acres of NFS land would be closed to geothermal leasing for direct and indirect use because these lands were found to be incompatible with geothermal leasing, exploration, and development. Additional lands might be closed to geothermal resource leasing for direct and indirect use due to local conditions at the discretion of the individual field offices and ranger districts.

Under this alternative, the BLM and FS would issue a comprehensive list of stipulations, best management practices, and procedures to serve as consistent guidance for future geothermal leasing for direct and indirect use. Relevant stipulations (Section 2.2.2) designed to minimize impacts on water resources and water quality include (1) no surface occupancy on water bodies, riparian areas, wetlands, playa, and 100-year floodplain; and (2) controlled surface use within 500 feet of riparian or wetland vegetation to protect the values and functions of these areas. In accordance with BMPs (Appendix D), operators would be required to gain a clear understanding of the local hydrology and would avoid creating hydrologic conduits between aquifers. Operators would also develop a storm water management plan for the site to ensure compliance with applicable regulations and to prevent off-site migration of contaminated water or increased soil erosion. It is expected that these measures, along with the measures outlined to protect soil resources, would effectively minimize impacts on water resources and quality by protecting sensitive surface and ground water resources, protecting wetland and riparian habitats, reducing water quality degradation (i.e., contamination and sedimentation), and meeting applicable water quality standards.

Impacts under Alternative C

Under Alternative C, approximately 61,200,000 acres of public land and 37,900,000 acres of NFS land would be identified as open to geothermal leasing for indirect use. Alternative C differs from Alternative B in that the BLM and FS would only consider indirect use leasing within 10 miles from the centerline of existing 60 kV to 500 kV transmission lines and at least 15 miles outside of the Yellowstone National Park boundary.

The comprehensive list of stipulations, best management practices, and procedures discussed under Alternative B would be applied to those areas within the transmission line buffer.

Areas open to direct use geothermal lease applications and impacts from their subsequent development would be the same as identified under Alternative B.

4.8 AIR QUALITY AND ATMOSPHERIC VALUES

4.8.1 What Did The Public Say About Impacts on Air Quality and Atmospheric Values?

Comments received during scoping requested that BMPs such as emissions monitoring, diesel exhaust abatement, dust control, and a requirement for Equipment Emissions Mitigation Plans be incorporated into lease terms. Comments included requests for the PEIS to discuss the criteria pollutants expected to be emitted from the various sources typically associated with geothermal projects as well as the timeframe for these emissions over the various project phases. From a regulatory standpoint, commentors requested that the PEIS discuss the applicability of General Conformity, New Source Review, and Operating Permits to geothermal projects. Commentors also requested that the PEIS address the reduction of regional air emissions that would be expected by expanding geothermal energy use.

4.8.2 How Were the Potential Effects of Geothermal Development on Air Quality and Atmospheric Values Evaluated?

Methodology

Potential effects of geothermal development on air quality were evaluated by examining the typical air emissions associated with the various stages of geothermal development, and comparing those emissions with areas of nonattainment across the planning area (shown in Table 3-13, Counties within the Planning Area that are Designated Nonattainment or Maintenance Areas for Criteria Pollutants). While geothermal leasing itself would not impact air quality, the impacts of development on leased areas could affect air quality in the future. These potential effects on air quality are those that may result from pollutants that are typically generated by geothermal development.

Other regulatory requirements that would likely be required at the project-specific phase of analysis and permitting are examined here and were considered in determining both the impact criteria and in developing the impact analysis.

A secondary analysis was conducted to estimate the carbon dioxide emissions that would be generated by geothermal power development, compared with conventional, fossil-fuel based energy production. This analysis was conducted using the estimates of mass of carbon dioxide generated per kilowatt hour by geothermal, natural gas, petroleum, and coal power production, as shown in Table 3-14.

Conformity Requirements

Section 176(c) of the Clean Air Act, 42 USC § 7506(c), requires federal agencies to ensure that actions undertaken in nonattainment areas are consistent with the Clean Air Act and with federally enforceable air quality management plans.

The EPA has promulgated separate rules that establish conformity analysis procedures for transportation-related actions and for other (general) federal agency actions. The EPA general conformity rule applies to federal actions occurring in nonattainment areas when the total direct and indirect emissions of nonattainment pollutants (or their precursors) exceed specified thresholds. The emission thresholds that trigger requirements of the conformity rule are called de minimis levels.

At project level analysis and permitting, the BLM and FS would need to ensure that any proposed action, including construction emissions subject to state jurisdiction, conform to an approved State Implementation Plan (SIP). Emissions authorized by a Clean Air Act permit issued by the state or by the local air pollution control district would not be assessed under general conformity but through the permitting process.

Air Permitting

The Clean Air Act and its subsequent amendments require the permitting of stationary sources. Permitting requirements for major air sources are contained in two different programs. The first program is the New Source Review program, which consists of two preconstruction programs: The Prevention of Significant Deterioration program for permitting sources in attainment areas, and the nonattainment area permitting program. The second program is the Operating Permits Program, for permitting a source once it is in operation.

New Source Review

Congress established the New Source Review permitting program as part of the 1977 Clean Air Act Amendments. New Source Review permitting is a preconstruction permitting program that:

- Ensures that air quality is not significantly degraded from the addition of new and modified factories, industrial boilers, and power plants. In areas with unhealthy air, New Source Review permitting assures that new emissions do not slow progress toward cleaner air. In areas with clean air, especially pristine areas like national parks, New Source Review permitting assures that new emissions do not significantly worsen air quality.
- Assures people that any large new or modified industrial source in their neighborhoods will be as clean as possible, and that advances in pollution control occur concurrently with industrial expansion.

New Source Review permitting permits are legal documents to which facility owners/operators must abide. The permits specify what construction is allowed, what emission limits must be met, and often how the source must be operated. They may contain conditions to make sure that the source is built to match parameters in the application that the permit agency relied on in their analysis.

For example, the permit may specify stack heights that the permit agency used in their analysis of the source. Some limits in the permit may be there at the request of the source to keep them out of other requirements. For example, the source may take limits in a minor New Source Review permitting permit to keep the source out of Prevention of Significant Deterioration permit. To assure that sources follow the permit requirements, permits also contain monitoring, recordkeeping, and reporting requirements.

The New Source Review permitting process includes a public involvement component. Members of the public can use the New Source Review permitting program to ensure that sources are complying with the requirements that apply to them. New Source Review permitting gives the public the opportunity to:

- Comment on and request a public hearing on permits before they are issued.
- Appeal permits issued pursuant to the State Implementation Plan. The appeal procedures will depend on the state the source is located in.
- Appeal EPA-issued permits or permits issued by state or local agencies that are issuing the permit on behalf of the EPA to the Environmental Appeals Board and the federal courts.

Authority to Construct and Permit to Operate

For a specific project, the local air district would issue an Authority to Construct permit during the drilling operations stage of a project to address air emissions from stationary sources, which at that stage of development would be the production wells. For a power plant, an Authority to Construct is usually initially acquired for the power plant, including the wells. Once the power plant is operational and any initial operational problems have been worked out, the air district then issues a Permit to Operate. Depending on the type of project and the amount and type of air emissions, abatement systems may be required by the local air district during this phase of permitting.

The EPA's Operating Permits Program was established through Title V of the Clean Air Act Amendments of 1990 and is considered to be the most important procedural reform in the amendments and the centerpiece for compliance with the entire act. Title V requires the establishment of an operating permit program for major stationary sources that would ensure compliance by industry with all applicable requirements of the act, enhance EPA's ability to enforce the Clean Air Act, generate state and tribal revenue to administer the program, enhance the ability of a permitting agency to track compliance and evaluate a source's air quality, ensure public involvement by allowing review and comment of draft permits, and increase certainty for industry by providing all source requirements in one permit document.

Impact Criteria

Potential impacts on air quality could occur if reasonably foreseeable future actions were to result in the following:

- Conflict with or obstruct implementation of the applicable air quality attainment plan;
- Violate any stationary source air quality standard or contribute to an existing or projected air quality violation; or
- Expose sensitive receptors (e.g., concentrations of children, elderly, or persons with respiratory conditions) to major pollutant concentrations.

4.8.3 What are the Common Impacts on Air Quality and Atmospheric Values Associated with Geothermal Development?

Due to the inability to predict future development scenarios, including types of development, timing, and location, the following impact analysis provides a general description of common impacts on air quality from geothermal resource development.

The nature and extent of geothermal-related development activities that would affect air quality would vary by project, depending on several factors: 1) whether the project is for direct use or indirect use; 2) the size of the project; and 3) for indirect projects, which type of power plant technology is used. Potential air quality impacts would be evaluated on a project-specific basis, as NEPA would be conducted for each of the potential phases of geothermal development activity: exploration, drilling operations, utilization, and reclamation and abandonment. Air permits would also be obtained, as necessary, for each individual phase, and activities at all sites would need to be carried out in conformance with the applicable SIPs. This section will qualitatively address the air quality impacts typically associated with each phase of development, and then examine the role the development of geothermal energy applications is likely to play in air quality nationwide.

Some activities resulting in air quality emissions are common to all phases of a geothermal project lifecycle, while others are specific to certain phases. Table 4-1 summarizes the activities and the criteria pollutants of concern related to those activities. Emissions from each phase of development are discussed in the following text.

The Reasonable Foreseeable Development Scenario for Air Quality and Atmospheric Values

As stated in the RFD scenario, it is estimated that 111 power plants would be constructed across the 12-state project area by 2015, and a further 133 power plants would be constructed by 2025. The average capacity of these power

Table 4-1
Activities and Related Pollutants from Geothermal Project Phases

Activity	Pollutant	Project Phase	Factors
Exhaust from vehicular traffic	Carbon monoxide, carbon dioxide, oxides of nitrogen, volatile organic compounds, particulates, sulfur dioxide, air toxics	All	Vehicle-miles traveled (VMT)
Fugitive dust from vehicle traffic on paved and unpaved roads	Particulates	All	VMT, road conditions
Fugitive dust from earth-moving activities	Particulates	All	Acres disturbed, soil conditions
Exhaust from construction equipment	Carbon monoxide, carbon dioxide, oxides of nitrogen, volatile organic compounds, particulates, sulfur dioxide, air toxics	All	Volume of fuel used, engine/abatement technology
Release of geothermal fluid vapor	carbon dioxide, hydrogen sulfide, mercury, arsenic, boron	Exploration, drilling operations, utilization	Chemical composition of geothermal resource, duration and volume of flow testing, frequency, duration, and volume of well blow-outs, type of power plant

plants is estimated to be 50 megawatts. For direct use, it is estimated that by 2015, applications could be developed in the amount of 1,600 thermal megawatts; by 2025, applications could be developed in the amount of 4,200 thermal megawatts. For indirect use, the RFD scenario estimates that up to 40,737 acres of land would be disturbed by 2015, and up to 89,548 acres of land would be disturbed by 2025. Such disturbances would be spaced both temporally across approximately 15 years, and spatially across the 12-state project area.

Exploration

Air quality impacts associated with exploration are short term and generally limited to the release of fugitive dust from surface disturbance and emissions from vehicles and construction and drilling equipment. Initial exploration activities such as surveying and sampling would have minimal air quality impacts from accessing exploration sites in roadless areas and from disturbing small areas of land for the placement of surveying equipment. Secondary exploration activities, specifically site clearing, exploration well pad development, and the drilling of temperature gradient wells would have more intensive exhaust-related emissions and would last for longer periods of time. Total time for exploration activities typically ranges between one and five years.

Drilling Operations

Air emissions during the drilling operations phase of a geothermal project include fugitive dust and emissions from combustion engines, as described above, but as successful wells are drilled, the new source of potential air pollution is from the venting of geothermal fluids to the atmosphere. Well venting introduces the potential for release of hydrogen sulfide, carbon dioxide, mercury, arsenic, and boron when these compounds are contained in the geothermal resource. The local air district may require establishing an air monitoring program, particularly if the well is proposed as a power generation project. Hydrogen sulfide is generally the primary pollutant of concern for air districts considering permitting a geothermal well.

The following specific activities during the drilling operations phase would result in emissions of fugitive dust and exhaust from combustion engines:

- Vehicle traffic on access roads (worker vehicles, equipment, watering trucks, materials delivery trucks);
- Removing vegetative cover;
- Constructing roads, well pads, lay-down areas, and landscaping involving excavation, moving soils, and grading;
- Drilling production wells – Drilling times vary considerably with the type of rock and depth of resource. Drilling rates of approximately 150 feet per day have been reported (Finger and Hoover 2003), bringing drill rig operating times into an estimated range of 10 days for a 1,500 foot well to nearly 70 days for a 10,000 foot well;
- Drilling injection wells; and
- Constructing fluid sump pits.

Utilization

Constructing a geothermal power plant and its associated infrastructure during the onset of the utilization phase would create the greatest amount of fugitive dust and exhaust from combustion engines.

By the onset of operations within the utilization phase, particularly for indirect use applications, an air monitoring system is usually already in place from the drilling operations phase. Such a monitoring system has typically been collecting pertinent baseline data about the nature of the emissions from the wells and later, for indirect uses, the power plant(s) over the course of development and construction.

Direct use applications likely have very few wells (typically one or two) and no emissions. Similarly, for a binary power plant, no emissions are realized during operations in the utilization phase, except for during well venting during maintenance activities, or leaks in the heat exchangers, which could result in the release of volatile organic compounds. Flash and dry steam power plants emit geothermal vapors to the atmosphere, potentially releasing the range of pollutants listed above under the drilling operations phase.

Fugitive dust and exhaust from combustion engines during operations within the utilization phase would be generally limited to worker and maintenance vehicle traffic.

Table 4-2 shows the carbon dioxide emission estimates from the projected 2015 and 2025 geothermal power plant electricity generation detailed in the RFD scenario, and compares it with estimated emissions for the same power generation from traditional fossil fuel sources. Calculations were based on the rate of carbon dioxide production per kilowatt-hour shown in Section 3.8, Air Quality for the various energy sources, derived from Bloomfield *et al.* (2003).

As shown in Table 4-2 it is estimated that development of the number of geothermal power plants estimated in the RFD scenario would result in emissions of approximately 554 tons of carbon dioxide per hour in 2015, and 1,216 tons of carbon dioxide per hour in 2025. Were the same electrical capacity to be produced by natural gas, petroleum, or coal, carbon dioxide emissions would be six-fold, nine-fold, and ten-fold, respectively.

Direct use applications are also expected to reduce carbon dioxide emissions through energy consumption offsets; however, it is difficult to quantify such offsets since in some cases, access to geothermal resources for direct use applications may actually stimulate economic growth around the resource and result in other types of emissions in a location that would otherwise not have the same degree of development and emission-generating activities.

Table 4-2
Hourly Carbon Dioxide Emissions at 2015 and 2025

	Geothermal (0.20 lbs. CO_2/kWh)	Coal (2.095 lbs. CO_2/kWh)	Petroleum (1.969 lbs. CO_2/kWh)	Natural Gas (1.321 lbs. CO_2/kWh)
2015 emissions per hour (5,540 MW)	554[1] tons	5,760 tons	5,410 tons	3,630 tons
2025 emissions per hour (12,160 MW)	1,216 tons	12,670 tons	11,910 tons	7,990 tons

[1]Sample calculation:
(5,540 MW) x (1,000 kW/MW) x (0.2 lbs CO_2/kW-h) x (0.0005 ton/lb) = 550 tons

Reclamation and Abandonment

Air quality impacts during reclamation and abandonment activities would be generally limited to emissions from vehicles and construction equipment and to fugitive dust from the movement of vehicles. Depending on the flow and temperature of the geothermal fluids or steam at the well heads at the time of abandonment, well capping could result in the potential release of the range of pollutants listed above under the drilling operations section.

4.8.4 What are the Potential Impacts on Air Quality and Atmospheric Values Associated with the Proposed Action and Alternatives?

The following discussion analyzes the environmental consequences or impacts expected to occur as a result of anticipated future actions consistent with implementing the alternatives described in Chapter 2.

The relationship between GHG emissions and climate change is discussed earlier, under Section 4.1. The discussion here is limited to a comparison in terms of possible GHG emissions and the potential for offsets between the respective approaches to development reflected in each of the alternatives.

Impacts under Alternative A

Under the no action alternative, lease applications would continue to be processed on a case-by-case basis. Areas closed to geothermal leasing by statute, regulation, or orders would remain closed, and discretionary closed areas would be assessed based on local land use plans. Under Alternative A, the pace of development of geothermal power plants or direct use projects would be lower than under Alternatives B and C, making it more likely that fossil-fuel based power plants would continue to be developed and that emissions at 2015 and 2025 would more closely resemble the estimates in the fossil-fuel based columns than in the geothermal column of Table 4-2. Compared with the other alternatives, Alternative A is expected to have the least beneficial effect on reducing GHG emissions.

Impacts under Alternative B

Alternative B would be expected to provide larger-scale and longer-term opportunities for improvements in air quality and reductions in greenhouse gases than Alternative A. At the project-level NEPA analysis, Clean Air Act conformity requirements would apply only to those lease areas within maintenance and nonattainment areas.

The large-scale development of geothermal energy applications for direct and indirect use across the western US has the potential to offset substantial emissions of criteria pollutants at the national level. Such development would help individual states meet their renewable portfolio standards and their increasing energy needs, while maintaining or improving air quality. The air quality impacts of geothermal exploration, drilling operations, utilization, and reclamation and abandonment are considered to be much less than the impacts associated with the alternative—development of nonrenewable energy sources such as oil, natural gas, and coal.

The wide-scale development of geothermal energy applications for direct and indirect use would at the least decrease the need for future development of more-polluting energy-generating applications, such as oil, natural gas, and coal, and would slow the increase in greenhouse gases being generated by the US. At best, the wide-scale development of geothermal energy applications for direct and indirect use would be an integral part of a shifting energy landscape in the US to renewable energy sources that would result in an overall decrease in greenhouse gas emissions.

Under Alternative B, emissions resulting from development at 2015 and 2025 would more closely resemble the estimates in the geothermal columns than in the fossil-fuel columns of Table 4-2. Compared with the other alternatives, anticipated future actions consistent with Alternative B are expected to have the greatest beneficial effect on reducing GHG emissions because of the greater potential for GHG offsets, as described in Section 4.8.3.

Under this alternative, the BLM and FS would issue a comprehensive list of stipulations, best management practices, and procedures to serve as consistent guidance for future geothermal leasing for direct and indirect use. In accordance with BMPs (Appendix D), operators would be required to minimize air quality impacts from fugitive dust, vehicle exhaust, and equipment operations. Operators would prepare and submit to the BLM an Equipment Emissions Mitigation Plan. Requirements for emissions controls would be incorporated into the terms of individual geothermal leases. It is expected that these measures would effectively minimize impacts on air quality and atmospheric values by reducing sources of air quality degradation including particulates and hydrocarbons.

Impacts under Alternative C

Impacts from anticipated future actions consistent with Alternative C would be greater than those consistent with Alternative A, but less than those consistent with Alternative B, since smaller land areas would be available for indirect use development, and less development would be likely to occur. While Alternative C would allow for a more expeditious achievement of offsets than Alternative A for states within the project area, Alternative C would be inferior to Alternative B in this regard.

Under Alternative C, emissions at 2015 and 2025 would likely be somewhere between the estimates in the geothermal columns and in the fossil-fuel columns of Table 4-2. Compared with the other alternatives, anticipated future actions following leasing under Alternative C are expected to have a greater beneficial effect on reducing GHG emissions than Alternative A, and a lesser beneficial effect than Alternative B.

Areas open to direct use geothermal lease applications and impacts from their subsequent development would be the same as identified under Alternative B.

At the project-level NEPA analysis, Clean Air Act conformity requirements would apply only to those lease areas within maintenance and nonattainment areas.

4.9 VEGETATION

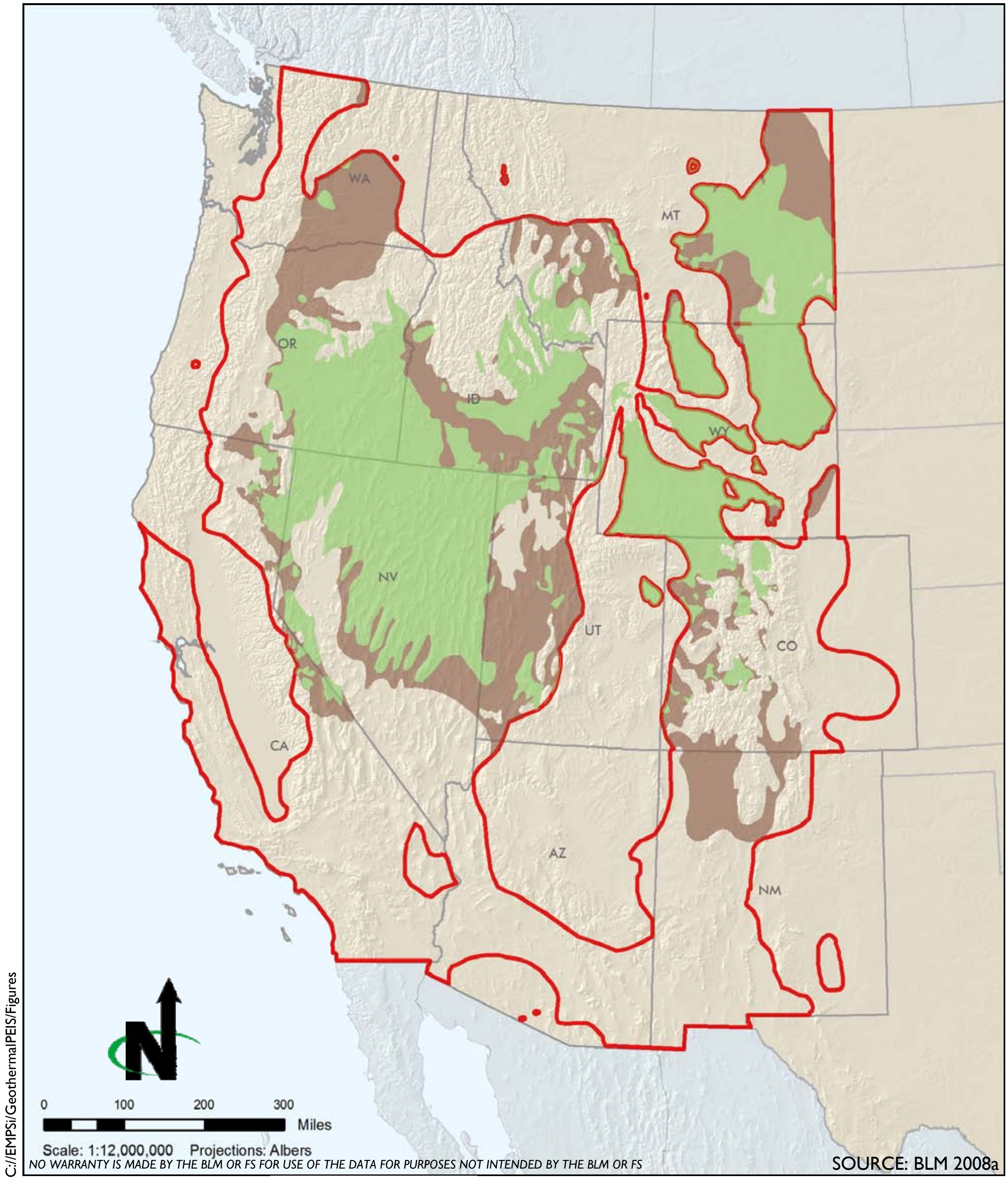
4.9.1 What did the Public Say about Impacts on Vegetation and Important Habitats and Communities?

Comments collected during scoping relating to vegetation and important habitats requested that the analysis of impacts address riparian and wetland habitat, important sagebrush habitats, winter range habitat, important terrestrial and aquatic plant and animal habitat, and the potential for introduction of invasive species. The effects of fragmentation and removal on these areas were the main concern addressed during scoping.

4.9.2 How Were the Potential Effects of Geothermal Development on Vegetation and Important Habitats and Communities Evaluated?

Leasing geothermal resources would not affect vegetation or important habitats and communities. These resources would be affected only by development of specific geothermal development projects that occurred subsequent to the leasing action. Potential impacts of geothermal development were evaluated based on the typical disturbance of geothermal projects for the various stages of development and then assessed based on projected location and intensity, as described in the RFD. The types of vegetation and important habitats and communities that could be affected by geothermal development on public and NFS lands depend on the ecoregions they exist and the specific location of the proposed project.

Figures 3-10 through 3-13 show the distribution of public and NFS lands with a potential for geothermal development, relative to ecoregion divisions and provinces that occur in the 12 western states. The types of vegetation, habitats, and communities that could be affected by geothermal development depend on the ecoregion in which the project is located (Appendix G provides more information on ecoregions). Specific impacts of a project depend on the types of vegetation and habitats present at the project location within the ecoregion province. The ecoregion provinces with the greatest extent of areas with medium to high potential for geothermal development are the Intermountain Semi-Desert and Desert and the American Semi-Desert and Desert (Figure 3-12 and 3-13). The vegetation communities in these ecoregions are largely arid and semiarid grass and shrub lands, including sagebrush (Figure 3-14). There is a notable decrease is distribution of sage brush obligate species, including sage grouse (Figure 4-1), which highlights the importance of the sagebrush community. Appendix G presents descriptions of the vegetation found within public and NFS lands with a potential for geothermal development across ecoregions of the 12 western states.



Greater sage grouse require contiguous, undisturbed areas of high-quality habitat during their four distinct seasonal periods of breeding, summer-late brooding and rearing, fall, and winter.

Current and Historical Sage Grouse Distribution in the Western United States

Figure 4-1

Impacts discussed are associated with the elimination and degradation of habitat occurring at project sites, in immediately adjacent areas, or within the individual project watershed(s). Potential impacts on vegetation and important habitats could occur if reasonably foreseeable future actions were to result in the following:

- Affect a plant species, habitat, or natural community recognized for ecological, scientific, recreational, or commercial importance;
- Affect a species, habitat, or natural community that is specifically recognized as biologically significant in local, state, or federal policies, statutes, or regulations;
- Establish or increase noxious weed populations;
- Destroy or extensively alter habitats or vegetation communities in such a way that would render them unfavorable to native species; or
- Conflict with BLM or FS management strategies.

4.9.3 What are the Common Impacts Associated with Geothermal Development?

Due to the inability to predict future development scenarios, including types of development, timing, and location, the following impact analysis provides a general description of common impacts on vegetation and important habitats from geothermal resource development.

The nature and extent of geothermal-related development activities that would affect vegetation and important habitats and communities would vary by project, depending on several factors: 1) whether the project is for direct use or indirect use; 2) the size of the project; 3) the geographic location; and 4) for indirect use, the type of plant. Potential vegetation and important habitat impacts would be evaluated on a project-specific basis, as NEPA would be conducted for each of the potential phases of geothermal development activity: exploration, development, operation, and closeout. This section will qualitatively address the impacts on vegetation and important habitats and communities.

The Reasonable Foreseeable Development Scenario for Vegetation and Important Habitats and Communities

The RFD scenario estimates 111 power plants would be constructed across the 12-state project area by 2015, and an additional 133 power plants would be constructed by 2025. The average capacity of these power plants is estimated to be 50 megawatts. This estimate assumes that up to 40,737 acres of land would be disturbed by 2015, and up to 89,548 acres would be disturbed by 2025 as part of indirect use geothermal projects. For direct use, it is estimated that applications could be developed in the amount of 1,600 thermal megawatts by 2015 and 4,200 thermal megawatts by 2025. Disturbance from development would be spaced both temporally across approximately 15 years, and spatially across the 12-state project area.

Regardless of the location of geothermal development projects, the nature of the impacts from exploration and development to vegetation and important habitats and communities would be similar in all ecoregions. Vegetation would be affected by direct destruction and removal, fugitive dust, exposure to contaminants, and the introduction of invasive species. The extent of the impacts is typically associated with the size of the area that is disturbed and the types of vegetation habitats and communities present. The ability of an area to recover from disturbance also affects the extent of the damage.

Impacts common to all vegetation and important habitats are discussed below, followed by an analysis of how those impacts might affect important habitats and communities within the planning area. Finally, any impacts that are specific to a certain stage of geothermal development (exploration, development, operation, or closeout) are discussed. Geothermal activities can cause the following stressors and associated impacts on vegetation and important habitats. Table 4-3, Potential Impacts of Vegetation and Important Habitats, provides a breakdown of the likelihood for impacts to occur during each phase of geothermal development (exploration, development, production, and closeout).

- Habitat disturbance - Site clearing, well drilling, constructing access roads and geothermal facilities, and maintenance and operational activities would disturb habitat, which would cause mortality and injury, increase the risk of invasive species, and alter water and seed dispersion and wildlife use, which can further affect vegetation communities.
- Direct Removal and Injury - Vegetation would be cleared for roadways, vehicle staging, buildings, pipelines, and transmission lines. Activities could result in loss of soil, loss of seed bank in soil, deposition of dust, and destruction of biological soil crusts. Maintenance around project components such as drill pads, buildings, pipelines, or other facilities would involve mowing, herbicide treatment, and other mechanical or chemical means of removal and control. This would result in a net loss of important habitats and communities throughout the planning area.
- Invasive Vegetation - Disturbance and access by vehicles and human foot traffic may expose areas to colonization by invasive and nonnative species, making it more difficult for endemic species to reestablish in disturbed areas and threatening the continued existence of endemic species (BLM 2007c).

Table 4-3
Potential Impacts of Vegetation and Important Habitats

Ecological Stressor	Geothermal Activity	Impact	Potential Level of Impact			
			Exploration	Drilling Operations	Utilization	Reclamation and Abandonment
Habitat disturbance	Site clearing and grading; well drilling and construction; pipelines, access road, and ancillary facility construction; construction and maintenance vehicle travel	Loss of vegetation, increase risk of invasive species, alter water and seed dispersion	Moderate	Moderate	Moderate to high	Low
Direct removal and Injury	Site clearing and grading; well drilling and construction; pipelines, access road, and ancillary facility construction; construction and maintenance vehicle travel	Direct destruction of vegetation, increase of invasive species	Moderate to high	Moderate to high	High	Low to moderate
Invasive vegetation	Site clearing and grading; well drilling and construction; pipelines, access road, and ancillary facility construction; construction and maintenance vehicle travel	Change species composition, increase risk of fire, eliminate native species	Low to moderate	Low to moderate	Moderate to high	Low to moderate

Table 4-3
Potential Impacts of Vegetation and Important Habitats

Ecological Stressor	Geothermal Activity	Impact	Potential Level of Impact			
			Exploration	Drilling Operations	Utilization	Reclamation and Abandonment
Fire	Site clearing and grading; well drilling and construction; construction and maintenance vehicle use; cigarette smoking	Direct mortality to vegetation, loss of seed bank, erosion, increased potential for invasive species, loss of species diversity	Low	Low	Moderate to high	Low
Erosion	Site clearing and grading; well drilling and construction; pipelines, access road, and ancillary facility construction; construction equipment travel	Reduced habitat quality, direct loss of vegetation, loss of topsoil and seed bank, increased risk of invasive species	Low to moderate	Low to moderate	Moderate	Moderate
Exposure to contaminants	Accidental spill during equipment refueling; accidental release of stored fuel or hazardous materials; drilling mud spill or accidental spill of geothermal fluids and working fluids; accidental spill of herbicides	Growth impairment, direct mortality, changes in species composition	Low	Low	Low	Low

The assessment of impact level is based on the RFD; and activities and projected disturbance associated with each stage geothermal development, as well evaluation of the efficacy of BMPs, stipulations and procedures available to eliminate or mitigate the potential impacts. Duration of the impact as well as potential for accidents factor into the assessment.

Low- The activities involved in geothermal development do not present a risk or have effective precautions, stipulations and BMPs, that would minimize the potential, intensity, and duration of impact associated the prospective ecological risk factor.

Moderate- The activities involved in geothermal development have a greater potential for impacts on wildlife, including accidents, unavoidable removal of habitat, and indirect disturbance. Impacts may be unavoidable and may endure beyond the conclusion of the activity.

High- The activities involved in geothermal activities would have direct and unavoidable impacts. BMPs and stipulations are not available to eliminate impacts. Additionally, the risk of accident may be higher or the duration of the impact may be last well beyond the conclusion of the geothermal activities.

- Fire – Equipment operation, increased vehicular and human traffic, using drilling muds, and extracting geothermal fluids can increase the risk of fires. Vehicles, electrical lines, and smoking can all result in accidental fires. Fires destroy vegetation and can aid in the establishment of invasive species.
- Erosion - Containment basins, site clearing, grading, constructing access roads, site runoff, and vehicle and human foot traffic cause erosion. The effects of erosion include top soil removal, seed bank loss, native vegetation loss, invasive species establishment, stream sedimentation, and flooding (which can affect riparian vegetation and riparian habitats).
- Exposure to Contaminants - Vehicle fuel, hydraulic fluid, solvents, cleaners, and geothermal fluids can all be harmful to vegetation and important habitats. Accidental spills can contaminate soils and water and directly harm vegetation. Licensed herbicide use would control vegetation around geothermal facilities and support structures. Spills of herbicides or acute exposure to herbicides can have adverse effects on non-target vegetation.

Riparian and Wetland Habitat
Riparian and wetland habitats are of high value to fish and wildlife and perform critical environmental functions such as flood control and water purification (NRC 1995). These habitats may be affected by activities associated with all phases of geothermal projects. Impacts on wetlands are regulated under the River and Harbors Act and Section 404 of the Clean Water Act. US Army Corp of Engineers permitting would be required for each project that disturbs wetlands under its jurisdiction, both within and outside of corridors. In addition, Executive Order 11990, Protection of Wetlands, requires all federal agencies to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands.

Riparian and wetland habitat may be cleared to provide access to geothermal sites, and water may be extracted from groundwater sources to support geothermal exploration, production, and operation. Habitat removal may result in increased stream temperatures, reduced wildlife presence, increased erosion, and sedimentation. Water extraction may result in lowered groundwater tables, which can affect stream flows and duration and can dewater wetland and marsh habitat. Changes in riparian and wetland hydrology can affect vegetation species assemblages and may eventually alter the wildlife species composition. Accidental spill of fuel, solvents, or geothermal working fluids could degrade water quality and affect riparian vegetation.

Riparian and wetland habitat can be adversely affected by invasive species such as salt cedar and Russian olive, which can be introduced during disturbance. Salt cedar is highly tolerant of high salinity soils, low water tables, wildfires, livestock browsing, and conventional weed controls. Native plant species are damaged by unusually large guilds of insects and plant pathogens, but salt cedar has few natural insect or plant pathogens in the planning area. Salt cedar and other invasive riparian plants can lower water tables, and they often establish soon after disturbance.

Riparian and wetland habitat in California, Nevada, and Idaho would be more susceptible to geothermal development than other states based on projections for geothermal development on public and NFS lands (Section 2.4, Reasonably Foreseeable Development Scenario). This would include ecoregions provinces in the Mediterranean, temperate desert, and tropical/subtropical desert divisions (Figures 3-11 and 3-13). However, geothermal development in California, Nevada, and Idaho would likely occur in drier areas where the riparian and wetland habitats are less abundant. Therefore, geothermal projects are less likely to be located directly adjacent to these habitats. Riparian and wetland habitats are relatively scarce throughout the west and are very important in drier ecoregions, thus should be avoided. The BLM and FS have best management practices intended to limit the impacts of actions that occur on public and NFS lands. Additionally, wetlands and riparian habitat are protected under the Clean Water Act and regional land use and forest plans.

Sagebrush

Sagebrush habitat is spread across almost the entire project area (with the exception of Alaska) and covers approximately 93 million in the western US, of which about 66 percent is on public and NFS lands (Connelly et al 2004). Within the planning area about 36 percent of the lands have sagebrush habitat. Sagebrush habitat is found throughout and is almost exclusive to the temperate desert ecoregion division, although sagebrush within the planning area is also found in the temperate steppe ecoregion division. The states with the greatest sagebrush cover within the planning area are Idaho (23 percent), Nevada (38 percent), Oregon (23 percent), and Wyoming (27 percent). The RFD scenario forecasts that by 2025 geothermal development would affect up to 89,548 acres over the 12-state planning area. If all geothermal development were to occur on sagebrush habitat, it would affect approximately 0.1 percent of the sagebrush habitat in the planning area. If geothermal development were to occur proportionately within all habitats, then forecasted development would affect 0.04 percent of sagebrush habitat within the planning area. Based on RFD scenarios, the amount of sagebrush habitat that would be disturbed is likely somewhere between the two forecasted estimates, as a greater proportion of development is forecasted to occur in states with a greater percentage of sagebrush habitat in areas of geothermal potential (Connelly et al. 2004).

Sagebrush habitat would be cleared for roadways, drill pads, buildings, and other infrastructure. Sagebrush is susceptible to fire and can take from 15 to 30 years to reestablish to pre-burn density and cover following a fire (Miller and Rose 1999). Invasive species increase the incidence and intensity of fires in sagebrush habitat (Connelly et al. 2004). Native sagebrush communities may not reestablish after intense or frequent fires, and conditions favorable to native sagebrush species may not be available in the future in these areas (BLM 2004e). Frequently repeated fires reduce or prevent reestablishment of sagebrush seedlings from nearby unburned plants. Fires may kill some seeds of native grasses in upper soil layers, significantly reducing seedling emergence in burned areas (BLM 2004e).

Both the BLM and FS maintain a list of best management practices meant to protect important habitats such as sagebrush during development. The BLM has developed specific guidance for managing sagebrush communities meant to protect and conserve sagebrush habitat during land use and development projects (BLM 2004e). More information on the compatibility of geothermal development with sagebrush communities and sage grouse can be found in Text Box 4.10-1 in Chapter 4.10, Fish and Wildlife.

Old Growth Forests

Geothermal projects occurring in old growth forests would require forest clearing. Old growth forests on federal lands are managed under FS and BLM forest plans. Both the FS and BLM have shifted their management of forested lands away from resource extraction and toward ecosystem management to protect old growth forests (Thomas et al. 2006). Old growth forests on public lands are found predominately in the Pacific Northwest (the marine ecoregion division), the Southern Sierra Nevada Mountains (Mediterranean and temperate desert ecoregion divisions), the Rocky Mountains (temperate desert division), and scattered areas through the southwest.

Old growth forests, which may have never been physically disturbed by activities such as logging, typically contain centuries-old trees or other plants that cannot be reestablished and would be permanently lost. Loss of such habitat would be considered a greater impact than loss of previously disturbed habitat. Most sensitive and high quality habitats, such as old growth forests, are found in the areas being excluded under the proposed action such as roadless areas, wilderness areas, and ACECs. Based on the RFD scenario, many of the areas within the planning area containing old growth forests are not expected to see development. Should development occur in areas with old growth forests, the development would not conflict with the applicable forest management plan and would undergo site-specific analysis prior to site development. In most cases, old growth forests would be avoided during development. In all cases, site-specific NEPA evaluation would occur to assess the impacts of projects within old growth forests. This would include compliance with the Endangered Species Act, which protects habitat for listed species such as the spotted owl, for which old growth forests are considered critical habitat.

Exploration

Exploration would disturb small areas of vegetation and habitat during the construction of access roads and drill pads. Habitat would be removed, and vegetation would likely be destroyed. Surveying and drilling activities could result in impacts from weed infestation. If the area is not used for development and production, it would be reclaimed within three years. Native species would be used to revegetate the area.

Drilling Operations

Large areas of vegetation would be cleared for expanded well pads, (to accommodate production wells, injection wells and sump pits), roadways, and other critical infrastructure. This would destroy vegetation, create erosion potential, and increase incidence of invasive weed infestation. Drilling operations would require increased vehicle traffic, which would require staging areas and parking areas. Increased traffic would create more fugitive dust and pollutants and would increase the potential for fuel spills and other contaminants associated with vehicle use.

Water used for drilling activities could affect wetland and riparian areas in surrounding areas, depending on how it is accessed. Drilling requires large amounts of water, and local drawdown of water tables can have a direct effect on wetlands and groundwater flows, which can directly affect riparian vegetation.

Utilization

The greatest amount of disturbance, vegetation clearing and injury would occur during the initial construction within the utilization phase. Large areas of vegetation would be cleared for well pads, power plants, pipelines, roadways, and other critical infrastructure. This would destroy vegetation, create erosion potential, and increase incidence of invasive weed infestation. Drilling operations would require increased vehicle traffic, which would require additional staging areas and parking areas. Increased traffic would create more fugitive dust and pollutants and would increase the potential for fuel spills and other contaminants associated with vehicle use.

Drilling operations could increase the spread of invasive species that can outcompete and alter the plant species assemblages in surrounding habitat through direct and indirect effects. The dispersal of invasive plant seeds by vehicles may affect native plant communities. In such cases, plant communities dominated by native vegetation may be replaced with plant communities dominated by invasive species. Other adverse impacts from the spread of invasive species may include the following:

- A decrease in biological diversity of ecosystems;
- A reduction in water quality and availability for wildlife species;

- A decrease in the quality of habitats for wildlife;
- Alterations in habitats needed by threatened and endangered species; and
- Health hazards, because some species are poisonous to humans, wildlife, and livestock.

Wetland and riparian areas would be affected by roadways and bridges that may be built to access drilling operation areas. Runoff from construction could increase turbidity in streams, and potential spills of fuels and other contaminants from vehicles and on-site construction activities could affect water quality. Water used for drilling activities could affect wetland and riparian areas in surrounding areas, depending on how it is accessed. Drilling requires large amounts of water, and local drawdown of water tables can have a direct effect on wetlands and groundwater flows, which can directly affect riparian vegetation.

Vegetation and important habitats would be affected by site maintenance activities that involve mowing or cutting vegetation, exposure to contaminants and herbicides, decreased water quality due to surface runoff, vehicle traffic that produces fugitive dust, and direct injury from human and vehicle traffic. Water tables could also be affected by the withdrawal of geothermal fluids that, over time, could reduce groundwater storage and potentially affect stream flows.

Wetlands and aquatic resources could be affected by human activities associated with increased access to public and NFS lands in the immediate vicinity of a geothermal project site. Potential impacts from increased access may include disturbance of vegetation in wetland and aquatic habitats and the introduction of invasive vegetation.

Site maintenance activities at geothermal project sites would likely include the licensed application of herbicides to control vegetation along access roads and around buildings and power plant structures for indirect-use projects. The accidental spill of herbicides may affect native vegetation in surrounding areas. Potential effects of such exposure are discussed in the following section.

Increased human activity associated with the utilization phase would increase the potential for fire. The potential for wildland fires would be greatest in the arid and semiarid ecoregions and would be expected to occur most often in summer and autumn, when native and invasive grasses have died back and fuel loads are at their greatest. Sagebrush is especially vulnerable to fires and may incur both short- and long-term effects (BLM 2004e). Big sagebrush plants are readily killed by fire, while native grasses and forbs are generally unharmed by fires (BLM 2004e).

Access roads and maintenance activities would increase vehicle and human traffic, which may result in direct injury to vegetation and increased incidence of invasive plants. Clothing and vehicles tires can carry seeds that spread invasive species (Marsh and Douglas 1997).

Reclamation and Abandonment

Reclamation and abandonment could have similar impacts as those described for construction as buildings and structures are removed, but on a smaller scale. Fire, erosion, and invasive vegetation would be the predominant potential impacts during the reclamation and abandonment phase. After all buildings and facilities are removed, the affected areas would be reclaimed and vegetation and habitats would be restored.

4.9.4 What are the Potential Impacts Associated with the Proposed Action and Alternatives?

The following discussion analyzes the environmental consequences or impacts expected to occur as a result of anticipated future actions consistent with implementing each of the alternatives described in Chapter 2.

Impacts under Alternative A

Under the no action alternative, lease applications would continue to be processed on a case-by-case basis. Areas closed to geothermal leasing by statute, regulation, or orders would remain closed, and discretionary closed areas would be assessed based on local land use plans. The number of acres that could impact vegetation and important habitats is unknown; however, impacts would be site-specific and similar to the impacts under the four phases of geothermal development identified under Section 4.9.3. Under this alternative, no comprehensive list of stipulations, best management practices, or procedures would be distributed to serve as consistent guidance for all future geothermal leasing and development for direct and indirect use. This would result in fragmented and segregated planning for vegetation and important habitats which often exponentially increases impacts. Development of the individual leasing approvals, stipulations, and best management practices would also continue to vary per site and delay application processing time.

Impacts under Alternative B

Under this alternative, the land closed to geothermal leasing for direct and indirect use would increase. The BLM and FS would close approximately 25,150,000 acres of public lands and 24,370,000 acres of NFS lands that are incompatible with geothermal leasing, exploration, and development.

These closed lands would protect vegetation and important habitats, specifically high-value habitats such as old growth forests and wetland and riparian areas, more than the no action alternative (Alternative A). Additionally, major constraints would be applied to leases to protect vegetation and important habitats from adverse impacts. For lands not closed to direct and indirect use leasing, potential geothermal development could still occur as forecasted in the RFD scenario.

Under this alternative, the BLM and FS would issue a comprehensive list of stipulations, best management practices, and procedures to serve as consistent guidance for future geothermal leasing for direct and indirect use. Relevant stipulations (Section 2.2.2) designed to minimize impacts on vegetation include (1) no surface occupancy on water bodies, riparian areas, and wetlands; (2) controlled surface use in areas that would adversely impact the continuity of migration corridors or important habitat; and 3) controlled surface use within 500 feet of riparian or wetland vegetation to protect the values and functions of these areas. In accordance with BMPs (Appendix D), operators would review existing information on species and habitats in the vicinity of the project area to identify potential concerns. Operators would also employ timing restrictions and design features (outlined in the BMPs in Appendix D) to avoid, minimize, or mitigate negative impacts on sensitive habitats. It is expected that these measures would effectively minimize impacts on vegetation by reducing human caused disturbance to species and habitats; indentifying revegetation, soil stabilization, and erosion reduction measures; managing for invasive/weed species; and promoting the enhancement and/or restoration of existing habitat conditions when appropriate.

Impacts under Alternative C

Under this alternative, 61,200,000 acres of public land and 37,900,000 acres of NFS lands within 10 miles of the centerline of existing transmission lines and at least 15 miles outside of the Yellowstone National Park boundary would be open to leasing for indirect use and subject to major and moderate constraints as detailed in Chapter 2. Approximately 81,950,000 acres of public land and 65,710,000 acres of NFS lands would be closed to leasing for indirect use.

There would be less land available for exploration and development of geothermal resources for indirect use than under Alternatives A or B.

Under this alternative there would be less impact on vegetation and important habitats and communities than the other alternatives, as large areas would be closed to leasing for indirect use. Lands open to leasing within 10 miles of the centerline of existing transmission lines and at least 15 miles outside of the Yellowstone National Park boundary would be subject to constraints that are intended to protect vegetation and important habitats. Additionally, lands within existing transmission line ROWs often have existing access and maintenance roads constructed that could potentially be used for geothermal development, further limiting the potential impacts on vegetation and important habitats.

Areas open to geothermal lease applications for direct use and impacts from their anticipated subsequent development would be the same as identified under Alternative B.

4.10 FISH AND WILDLIFE

4.10.1 What did the Public Say about Impacts on Fish and Wildlife?

Comments collected during scoping focused on the potential impacts on big game species, sagebrush-dependent species, the potential for habitat fragmentation and disturbance, and risks to seasonal habitat such as wintering areas. Other comments were directed toward impacts on important habitats such as riparian habitat, wetlands, and old growth forest that are also addressed in Section 4.9, Vegetation.

4.10.2 How Were the Potential Effects of Geothermal Development on Fish and Wildlife Evaluated?

Leasing of geothermal resources does not affect fish and wildlife. These resources would be affected only by development of specific geothermal projects. Potential impacts of geothermal development were evaluated based on the typical disturbance of geothermal projects for the various stages of development and then assessed based on projected location and intensity, as described in the RFD scenario. The types of fish and wildlife that could be affected by geothermal development on public and NFS lands depend on the specific location of the proposed project, the time of year, the project design, and its environmental setting.

Specific impacts of a geothermal project depend on the size of the project and the methods used for construction. Impacts on wildlife are associated strongly with impacts on wildlife habitat. Wildlife depend on specific habitats for foraging, breeding, migration, and cover. General impacts on vegetation, riparian, wetland, sagebrush, and old growth habitats are discussed in Section 4.9, Vegetation. The wildlife present in and the extent of impacts depends on the ecoregion in which geothermal activities occur. Impacts discussed in this section are associated with the elimination and degradation of wildlife habitat at project sites, in immediately adjacent areas, or within the watershed, as well as impacts on wildlife from noise disturbance, displacement, mortality from vehicle collisions, and effects from invasive species. Potential impacts on fish and wildlife could occur if reasonably foreseeable future actions were to result in the following:

- Adversely affect a population by substantially reducing its numbers, causing a fish or wildlife population to drop below self-sustaining levels, or causing a substantial loss or disturbance to habitat. Such effects could include vehicle impacts and crushing, increased predation, habitat fragmentation, or loss of seasonal habitat;
- Have a substantial adverse impact on nesting migratory birds, including raptors, as protected under the Migratory Bird Treaty Act;
- Interfere with the movement of any resident or migratory fish or wildlife species, or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites;

and conflict with the wildlife management strategies of the BLM or FS.

4.10.3 What are the Common Impacts on Fish and Wildlife Associated with Geothermal Development?

Due to the inability to predict future development scenarios, including types of development, timing, and location, the following impact analysis provides a general description of common impacts on fish and wildlife from geothermal resource development.

The nature and extent of geothermal-related development activities that would affect fish and wildlife would vary by project, depending on several factors: 1) whether the project is for direct use or indirect use; 2) the size of the project; 3) the geographic location; and 4) for indirect use, the type of plant. Fish and wildlife and wildlife habitat would be evaluated on a project-specific basis, as NEPA would be conducted for each of the potential phases of geothermal development activity: exploration, drilling operations, utilization, and reclamation and abandonment. This section will qualitatively address the impacts on fish and wildlife.

Impacts common to fish and wildlife across the entire planning area are discussed below, followed by impacts that are specific to a certain stage of geothermal development (exploration, drilling operations, utilization, or reclamation and abandonment).

The Reasonable Foreseeable Development Scenario for Fish and Wildlife

The public and NFS lands that would be affected within the planning area cover approximately 246,736,368 acres. The RFD scenario estimates that by 2025 less than 0.1 percent (89,548 acres) of that land would be disturbed by geothermal projects. The disturbance would be spread both spatially and temporally across the planning area. Many of these disturbed areas would be reclaimed shortly after disturbance.

The effects of implementing the RFD scenario would have very little effect on most species populations. The fish, reptile, amphibian, bird, and mammal populations in the planning area are diverse and widespread and typically have high rates of mortality and natality. Thus, implementing the RFD scenario would affect relatively small areas of habitat and would typically affect individual species instead of large populations. The instances where individuals, communities, or populations can be affected from geothermal activities involve the following stressors and associated impacts on vegetation and important habitats:

- Habitat disturbance - The fragmentation of wildlife habitat for species requiring large contiguous tracts can be affected by site clearing, well drilling, construction of access roads and geothermal facilities, and maintenance and operational activities that would disturb habitat. These activities could cause disruption of breeding and migration, mortality and injury, increased risk of invasive species, and alteration of water and seed dispersion and wildlife use, which can further affect vegetation communities.

- Invasive Vegetation - Disturbance and access by vehicles and human foot traffic may expose areas to colonization by invasive and nonnative species, making it more difficult for endemic species to reestablish in disturbed areas and threatening the continued existence of endemic species (BLM 2007c). This can affect wildlife by reducing habitat quality and species diversity, thereby affecting foraging and breeding behavior.
- Injury or Mortality - Wildlife could be injured or killed during roadway clearing, vehicle staging, building construction, and other activities. Small or less mobile animals such as reptiles, amphibians, and rodents would be most susceptible to injury or mortality from geothermal activities. Maintenance around project components such as drill pads, buildings, pipelines, or other facilities would involve mowing, herbicide treatment, and other mechanical or chemical means of controlling vegetation that could directly affect species that depend on that vegetation for food, cover, or other habitat needs.
- Erosion and runoff - Site clearing, grading, access roads construction, containment basins, site runoff, and vehicle and human foot traffic cause erosion. The effects of erosion include the loss of habitat for terrestrial species and increased turbidity, which can directly affect fish and other aquatic biota.
- Fire – Increased vehicular and human traffic, equipment operation, and geothermal fluid extraction can increase the risk of fire. Vehicles, electrical lines, and smoking can all result in accidental fires. During fires, wildlife can be killed or injured. After fires, wildlife may be forced to move to other habitats or may be without suitable habitat for important behavioral activities.
- Noise - Constructing and operating geothermal facilities can produce noise far above normal ambient levels. Many species are sensitive to increases in noise that may cause disruption of breeding, migration, wintering, foraging, and other behavioral activities.
- Exposure to Contaminants - Vehicle fuel, hydraulic fluid, solvents, cleaners, and geothermal fluids can all be harmful to fish and wildlife. Accidental spills can contaminate soils and water and indirectly harm wildlife. Licensed herbicide use would likely be used to control vegetation around geothermal facilities and support structures. Spills of herbicides or acute exposure to herbicides can have adverse effects on wildlife.

Fish and Aquatic Biota

Impacts on fish and aquatic biota from geothermal projects are directly linked to impacts on riparian and wetland habitats in most cases. Impacts would result primarily from activities occurring near or in water bodies. Potential causes include ground disturbance, vegetation removal, groundwater withdrawal, road construction and excavation, structure and other facility installation (e.g., transmission towers or pipelines), and release of water contaminants. The effects of such actions could include changes in hydrology, increased turbidity, changes in water quality (e.g., temperature, dissolved oxygen, pollutants), loss of riparian vegetation (an indirect aquatic food source), restriction of fish movement and migration, and changes in predator and human use of the aquatic habitat. Impacts would vary in severity based on the type of aquatic habitat, the density, type, and number of species, and the method and stage of geothermal development.

Disturbance of adjacent ground and direct stream disturbance could result in increased turbidity. Sediments resulting from geothermal development would settle on the stream bottom downstream of the disturbance. The size of the particles and the stream flow would dictate how far the sediment is carried. Some fish such as salmonids and some aquatic insects are highly susceptible to increased turbidity. Particles in water can impair their ability to absorb oxygen, decrease survival of eggs, larvae, and fry, interfere with feeding and spawning, and decrease their ability to elude predators.

Stream flow rates are affected by the upland vegetation and adjacent terrain; therefore, geothermal development could alter stream flows and affect aquatic species and habitat. Typically, BMPs are instituted to control, reduce, or eliminate impacts on fish and aquatic biota by limiting how close development can occur and the grade of the slope that can be developed and by reclaiming areas immediately following the commencement of geothermal activities.

The severity of impacts associated with sedimentation depends largely on the receiving waters and the timing of the sedimentation event. Waters that are typically clear and cold are most susceptible to increased turbidity. These waters include higher mountain streams, often at more northern latitudes. These waters are more common to salmonid species (salmon, trout, char, and whiting). Some fish and aquatic species are adapted to large pulse events that occur seasonally and often are associated with large amounts of runoff and sediment. These species are found primarily in warmer waters and in desert climates were monsoons are normal.

Removal of riparian vegetation can increase water temperatures in adjacent streams. Trees and overhanging shrubs limit the amount of solar heat radiation that reaches the water and help maintain microclimates of higher humidity and lower temperatures. Increased water temperatures can impair growth, limit reproduction, alter competitive advantage (sometimes favoring invasive species), and limit survival in the affected area during periods of elevated temperature. Water temperatures for cold-water species (trout and salmon) cannot exceed 68˚F for more than short periods of time. Warm-water species are also subject to increases in water temperatures where waters have reached the upper bounds of the tolerable range. Small streams and water bodies are more susceptible to increased temperatures resulting from removal of vegetation. The BLM and FS have best management practices that limit the amount of riparian vegetation that can be removed. This includes a stream buffer that typically excludes development and surface disturbance.

Streams, rivers, and other waterways are at risk of exposure to toxic materials (fuel, herbicides, hydraulic fluid, drilling muds, geothermal working fluids) present as part of geothermal projects. The severity of impacts caused by toxics would depend on the type and amount introduced to the waterway, as well as on the time, location, and nature of the water body. Toxics are not expected to enter waterways, as stipulations and best management practices are intended to protect waterways from fuel spills and accidental releases.

Geothermal development can also cause impacts on fish and aquatic biota by facilitating access to areas. Human traffic may increase as the result of new roadways. Increased use can cause erosion and compaction of soil and may increase fishing or harvesting pressure.

Essential Fish Habitat (EFH) for salmonids within the planning area is found in Alaska, California, Idaho, Oregon, and Washington. EFH for salmonids consists predominately of coastal streams and rivers that lie north of Point Conception in Central California to Cape Prince of Whales in Alaska. EFH could be affected by the same activities and stressors mentioned above that affect other fish and riparian and wetland habitats. Erosion from project activities can cause increased turbidity in waterways. Changes in stream flows resulting from water use can also affect EFH, as can contaminants such as spilled fuel or herbicides that make their way into waterways.

Wildlife

Wildlife would be affected by the alteration, removal, reduction, or fragmentation of habitat. Habitat at drilling pads, facilities, roadways, and transmission corridors would be affected. The extent of the disturbance would be a function of the level of preexisting disturbance, the size, scale, and phase of geothermal development, and the type and quality of habitat. Geothermal development would have the greatest impact on wildlife if it were to affect specialty habitats such as riparian areas, wetlands, or wintering and breeding areas.

Fragmentation would affect wildlife by altering how wildlife species use the habitat. Fragmentation can separate wildlife populations into smaller populations, making them more vulnerable to predation, drought, and disease and limiting genetic diversity within breeding groups. Movement between habitat tracts is more difficult after fragmentation. Roads have been shown to impede the movements of invertebrates, reptiles, and small and large mammals (Strittholt et al. 2006. Habitat fragmentation can create increased edges for access by predators and invasive species and can facilitate access by hunters, reducing the density and diversity of wildlife species found in the original habitat (Anderson et al. 1977). Habitat fragmentation and degradation is considered a causal factor for the decline in sage grouse throughout most of its range (Strittholt et al. 2006). Text box 4.10-1 provides more information on sage grouse impacts and compatibility with geothermal development on public and NFS lands.

Animals displaced by fragmentation would occupy nearby habitats, which could lead to an increase in competition for resources and result in decreased health and potentially death for less fit individuals. The impacts resulting from displacement after habitat removal and fragmentation depend on many factors, including the sensitivity of a species to edge and area effects, the duration and rate of habitat loss and fragmentation, and the proximity of a chosen habitat to the disturbed area (Hagan et al. 1996).

Areas adjacent to disturbance resulting from geothermal development would likely be avoided by wildlife; therefore, the amount of habitat actually affected from disturbance and fragmentation extends beyond the habitat disturbed. The effective habitat loss (amount of habitat actually used by wildlife) due to new roadways was reported to be 2.5 to 3.5 times as great as actual habitat loss (Reed et al. 1996).

Fragmentation can facilitate the spread and introduction of invasive plant species (a more thorough discussion of effects on vegetation is found earlier in this section). Roads and other corridors can facilitate the dispersal of invasive species by altering existing habitat conditions, stressing or removing native species, and allowing easier movement by wild or human vectors (Trombulak and Frissell 2000).

Wildlife can be affected by invasive vegetation. Invasive plant species may be unpalatable for native animal species, making it difficult for them to forage. This can alter the population structure of entire habitats. Birds are most directly affected by invasive plants, as their food source is often seeds from native grasses and shrubs. Invasion of exotic species on public lands has been estimated at more than 5,000 acres per day. Cheatgrass is expected to dominate or completely convert more than half of the native sagebrush habitat in the United States (Strittholt et al. 2000); thus, sage grouse can be directly affected by cheatgrass infestations on sagebrush habitats.

Wildlife habitat in riparian areas is especially vulnerable to devastation by weeds because of the extra moisture and seed transport into these areas. Perennial pepperweed, leafy spurge, Russian knapweed and tamarisk (also known as salt cedar) easily form monocultures along riparian areas and adjacent uplands. Purple loosestrife forms solid stands, crowding out food plants needed by ducks and geese and reducing suitable nesting sites. Muskrats and long-billed marsh wrens leave infested areas (Thompson et al 1987). Tamarisk has been able to outcompete willow and other riparian plants in many locations, greatly diminishing the quantity and quality of riparian habitat for migrant songbirds and vegetation-dependent birds like the endangered Yuma clapper rail at the Salton Sea and elsewhere (Dudley 1995).

The direct injury and mortality of wildlife would likely occur as a result of geothermal development associated with the RFD scenario. Equipment used for clearing vegetation, roadways, well pads, and facility sites and vehicles used during operation and closeout would affect wildlife that are not mobile enough to avoid construction operations. Reptiles, amphibians, and small mammals would be most susceptible. More mobile wildlife species such as deer, birds, and large predators may avoid the initial clearing activity by moving into habitats in adjacent areas. Some of these animals may not survive if surrounding areas are at carrying capacity, or they may outcompete current residents.

Access road development increases land use by recreationalists and other users of public and NFS lands. This increases the amount of human presence and the potential impacts on wildlife from hunting, vehicle collision, harassment, and legal or illegal taking of wildlife. Access roads not needed for maintenance would be removed following exploration and development, and public use of these access roads would be restricted; therefore, roadkills would not be expected to result in a significant impact from a wildlife population perspective.

Noise from geothermal activities can have adverse impacts on wildlife. Principal sources of noise from geothermal activities would include trucks and the operation of drilling rigs and heavy machinery. The most adverse impacts associated with noise could occur if critical lifecycle activities were disrupted (e.g., mating and nesting). All wildlife could be disturbed by noise. Disturbance occurring during mating, nesting, or rearing of young can cause wildlife to abandon mating and nesting activities and can strand young, leaving them susceptible to predation and starvation.

On the basis of the types of equipment that would likely be used such as drill rigs and graders, the noise levels associated with the equipment would range from about 80 to 90 dBA within 50 feet; site preparation noise would be at the mid-40-dB level approximately 0.25 mile from the site (Section 3.19 Noise).

Hazardous materials resulting from accidental fuel spills, drilling muds, geothermal fluids, or releases of hazardous materials could result in the exposure of wildlife at the geothermal project sites. Potential impacts on wildlife would vary according to the material spilled, the volume of the spill, the location of the spill, and the species that could be exposed. Spills could contaminate soils and surface water and could affect wildlife associated with these media. A spill would be expected to have a population-level adverse impact only if the spill was very large or contaminated a crucial habitat area where a large number of individual animals were concentrated. The potential for accidental spills to have adverse effects on wildlife populations is unlikely, because the amounts of fuels and hazardous materials are expected to be small, so an uncontained spill would affect only a limited area (much less than one acre). In addition, wildlife use of the area would be minimal, greatly reducing the potential for exposure.

The location and timing of geothermal activities (especially exploration and development) may affect the migratory and other behavioral activities of some species. Construction activities could affect local wildlife by disturbing normal behavioral activities such as foraging, mating, and nesting. Wildlife may cease foraging, mating, or nesting or may vacate active nest sites in areas where geothermal activities are occurring; some species may permanently abandon the disturbed areas and adjacent habitats. In addition, active exploration and development may affect movements of some birds and mammals; for example, they may avoid a localized migratory route because of ongoing construction (BLM 2005b).

Reptiles and Amphibians

Geothermal activities may result in increased erosion and runoff from cleared and graded sites. This erosion and runoff could reduce water quality in on-site and surrounding water bodies that are used by amphibians, thereby affecting reproduction, growth, and survival. Water quality impacts during exploration, development, and closeout would be short term. Any impacts on amphibian populations would be localized to the surface waters receiving site runoff. Although the potential for runoff would be temporary, pending the completion of activities and the stabilization of disturbed areas with vegetative cover, erosion could result in significant impacts on local amphibian populations if an entire recruitment class is eliminated (e.g., complete recruitment failure for a given year because of siltation of eggs or mortality of aquatic larvae).

As mentioned above, reptiles and amphibians would have a difficult time vacating areas under geothermal development and could be crushed or injured during geothermal site and access roadway clearing. Following habitat removal or degradation, reptiles and amphibians may become more susceptible to predators or may be forced into adjacent habitats were the areas have reached carrying capacity.

Birds

The birds that are most susceptible to being adversely affected by geothermal projects are those whose mating or nesting habitats may be directly affected by geothermal activities. Birds that use the areas for foraging or migration would be relatively unaffected, as they would fly to adjacent habitat. Sagebrush species such as sage grouse would be directly affected.

Sage Grouse and Geothermal Development

Most concerns about the effects of geothermal development on sage grouse have focused on the potential impacts associated with reducing, fragmenting, and modifying grassland and shrubland habitats, particularly sagebrush. The Gunnison sage grouse (*Centrocercus minimus*) and particularly the greater sage grouse (*C. urophasianus*) are of concern relative to sagebrush habitat reduction and fragmentation that is occurring within every state in the planning area except Alaska. Sagebrush habitat in the planning area, as mentioned above, is found almost exclusively in the temperate desert ecoregions province, though some areas in the far eastern portion of the planning area can be found in the temperate steppe ecoregion division.

The Gunnison sage grouse is restricted to southwestern Colorado and southeastern Utah, while the greater sage grouse inhabits every planning area state except Alaska, Arizona, and New Mexico. The following discussion emphasizes the more widely distributed greater sage grouse. Figure 4.10-1 shows current and historic sage grouse distribution throughout the project area. Table 4-4 shows the percentage of lands occupied by sage grouse when compared to historical distribution within the planning area.

Table 4-4
Percentage of Lands Occupied by Sage Grouse vs. Historic Distribution within the Planning Area

State	Percent of Historic
Alaska	N/A
Arizona	0% (extirpated)
California	70.2%
Colorado	64.6%
Idaho	78.3%
Montana	85.8%
Nevada	19.1%
New Mexico	0% (extirpated)
Oregon	46.0%
Utah	25.2%
Washington	3.82%
Wyoming	4.6%

Source: Shroeder 2002

Populations of greater sage grouse can vary from nonmigratory to migratory (having either one-stage or two-stage migrations) and can occupy an area that exceeds 1,040 square miles on an annual basis. The distance between leks (areas used for courtship) and nesting sites can exceed 12.4 miles (Connelly et al. 2004). Nonmigratory populations can move 5 to 6 miles between seasonal habitats and have home ranges up to 40 square miles. The distance between summer and winter ranges for one-stage migrants can be 9 to 30 miles apart. Two-stage migrant populations make movements between breeding habitat, summer range, and winter range. Their annual movements can exceed 60 miles. The migratory populations can have home ranges that exceed 580 square miles (Bird and Schenk 2005). The greater sage grouse has a high fidelity to a seasonal range. They also return to the same nesting areas annually (BLM 2004e; Connelly et al. 2004).

The greater sage grouse needs contiguous, undisturbed areas of high-quality sagebrush habitat. They are omnivorous and consume primarily sagebrush and insects. Over 99 percent of their diet in winter consists of sagebrush leaves and buds. Sagebrush is also important as roosting cover, and the greater sage grouse cannot survive where sagebrush does not exist (Connelly et al. 2004).

Leks are generally areas supported by low, sparse vegetation or open areas surrounded by sagebrush that provide escape, feeding, and cover. They can range in size from small areas of 0.1 to 10 acres to areas of 100 acres or more (Connelly et al. 2000). The lek/breeding period occurs March through May, with peak breeding occurring from early to mid-April. Nesting generally occurs 1 to 4 miles from lek sites, although it may range up to 11 miles (BLM 2004e). The nesting/early brood-rearing period occurs from March through July. Tall, dense grass combined with tall shrubs at nest sites decreases the likelihood of nest depredation. Hens have a strong year-to-year fidelity to nesting areas (BLM 2004e). The late brood-rearing period occurs from July through October (BLM 2004). The greater sage-grouse occupies winter habitat from November through March. Suitable winter habitat requires sagebrush 10 to 14 inches above snow level with a moderate canopy cover. Wintering grounds are potentially the most limiting seasonal habitat for greater sage grouse (BLM 2004e; Connelly 2000).

Loud, unusual sounds and noise from construction and human activities disturb sage grouse and birds in general and can reduce sage grouse use of leks (Connelly et al. 2004). Disturbance at leks appears to limit reproductive opportunities and may result in regional population declines. Most observed nest abandonment is related to human activity (NatureServe 2007). Thus, site construction, operation, and site maintenance activities could be a source of auditory and visual disturbance to sage grouse.

Geothermal facilities, well pads, transmission lines, pipelines, and access roads may adversely affect habitats important to sage grouse by causing fragmentation, reducing habitat value, or reducing the amount of habitat available (Connelly et al. 2004). Geothermal facilities, transmission lines, pipelines, and other structures can also provide perches and nesting areas for raptors and ravens that may prey upon sage grouse. Sage grouse are also susceptible to vehicular collision along dirt roads because they are sometimes attracted to the dirt roads to take dust baths (Strittholt et al. 2000).

Measures that have been suggested for managing sage grouse and their habitats (Connelly et al. 2000) that have pertinence to geothermal projects include the following:

- Identify and avoid both local (daily) and seasonal migration routes.
- Consider sage grouse and sagebrush habitat when designing, constructing, and utilizing project access roads and trails.
- Avoid siting geothermal developments in breeding habitats.
- Adjust the timing of activities to minimize disturbance to sage grouse during critical periods.
- When possible, locate geothermal-related facilities away from active leks or near other sage grouse habitat.
- When possible, restrict noise levels to 10 dB above background noise levels at lek sites.
- Minimize nearby human activities when birds are near or on leks.
- As practicable, do not conduct surface-use activities within crucial sage grouse wintering areas from December 1 through March 15.
- Maintain sagebrush communities on a landscape scale.
- Provide compensatory habitat restoration for impacted sagebrush habitat.
- Avoid the use of pesticides at sage grouse breeding habitat during the brood-rearing season.
- Develop and implement appropriate measures to prevent the introduction or dispersal of noxious weeds.
- Avoid creating attractions for raptors and mammalian predators in sage grouse habitat.
- Consider measures to mitigate impacts at off-site locations to offset unavoidable sage grouse habitat alteration and reduction at the project site.

The BLM manages more sage grouse habitat than any other entity; therefore, it has developed, in conjunction with the NFS and state agencies, a National Sage Grouse Habitat Conservation Strategy for BLM-administered public lands to manage public lands in a manner that would maintain, enhance, and restore sage grouse habitat, while providing for multiple uses of BLM-administered public lands (BLM 2004e). The strategy is consistent with the individual state sage grouse conservation planning efforts. The purpose of this strategy is to set goals and objectives, assemble guidance and resource materials, and provide more uniform management direction (BLM 2004e). The strategy includes guidance for addressing sagebrush habitat conservation in BLM land use plans and for managing sagebrush plant communities for sage grouse conservation. This guidance is designed to support and promote the conservation of sagebrush habitats for sage grouse and other sagebrush-obligate wildlife species on public lands, and presents a number of suggested management practices (SMPs). These SMPs include management or restoration activities, restrictions, or treatments that are designed to enhance or restore sagebrush habitats. BMPs that are or may be pertinent to geothermal projects include the following:

- Develop monitoring programs and adaptive management strategies;
- Control invasive species;
- Prohibit or restrict ATV activity;
- Consider sage-grouse habitat needs when developing restoration plans;
- Avoid placing facilities in or next to sensitive habitats such as leks and wintering habitat.
- Locate or construct facilities so that facility noise does not disturb grouse activities or leks;
- Consolidate facilities as much as possible;
- Initiate restoration practices as quickly as possible following land disturbance;
- Install antiperching devices on existing or new powerlines in occupied sage grouse habitat; and
- Design facilities to reduce habitat fragmentations and mortality to sage grouse.

In addition to BLM's National Sage Grouse Habitat Conservation Strategy, the Western Association of Fish and Wildlife Agencies has produced two documents that together comprise a Conservation Assessment for Greater Sage Grouse. The first is the Conservation Assessment of Greater Sage-Grouse and Sagebrush Habitats (Connelly et al. 2004). The second document is the Greater Sage-Grouse Comprehensive Conservation Strategy (Stiver et al. 2006).

The density of several forest-dwelling bird species can increase within a forest stand soon after the onset of fragmentation, as a result of displaced individuals moving into remaining habitats (Hagan et al. 1996). Nests along habitat edges created from geothermal projects could be more vulnerable to predators. The developed geothermal areas may also encourage population expansion of invasive bird species such as the house sparrow and European starling, which compete with many native species. Fragmenting forests into small patches is detrimental to many migrant songbird species (Parker et al. 2005).

Noise can have direct effects on birds of all species by affecting their ability to hear, defend territory, identify predators, and learn songs (Larkin 1996). Studies have examined the effects of continuous noise on bird populations, including the effects of traffic noise, coronal discharge along electricity transmission lines, and turbines. Results indicate reduced densities as far as two miles from noise sources (Larkin 1996), with threshold effects at a level of 47 dBA for all species combined and 42 dBA for the most sensitive species; the observed reductions in population density were attributed to a reduction in habitat quality caused by elevated noise levels (Reijinen et al. 1996). This threshold sound level is at or below the sound levels generated by truck traffic that would likely occur at distances of 250 feet or more from access roads or geothermal project sites, and equivalent to that of construction noise almost 2,500 feet away.

Big Game

Geothermal projects could reduce the amount of suitable winter cover and forage available to big game, depending on their location. Long-term displacement of elk, mule deer, pronghorn, or other species from crucial winter habitat or calving areas due to habitat disturbance would directly impact these animals. An inability to use calving or wintering areas can directly affect populations because they may be unable to reproduce or may become stressed during harsh winter months, which can lead to death or decreased fitness.

Big game animals may also be affected if a geothermal facility, pipeline, or access road were to interfere with migratory movements. Herd animals, such as elk, deer, and pronghorn, could potentially be affected if projects affect migration paths between winter and summer ranges or in calving areas. Large predators, such as grizzly bear and mountain lion, require access to prey species and rely on migration corridors to follow prey species and hunt. Loss of habitat continuity along migration routes could severely restrict the seasonal movements necessary to maintain healthy big game and large predator populations (Watson 2005).

Exploration

The overall impact of geothermal exploration on fish and wildlife populations at a geothermal project site would depend on the type and amount of wildlife habitat at the site, as well as the amount of area that would be disturbed. The main impacts on wildlife during exploration are habitat removal, the potential for direct injury and mortality from vehicle travel, temporary noise impacts, and long-term effects from invasive species that may be introduced during exploration or reclamation of the affected area. Exploration activities are short term, and impacts on fish and wildlife would be temporary, with the exception of invasive species. Exploration activities often have very little disturbance on wildlife and wildlife habitat, as they may use existing roadways and disturbed areas during drilling of temperature gradient wells. Impacts from exploration would be similar to those described for development, but to a lesser extent and over a shorter time frame. The severity of impacts during each stage of a geothermal project (exploration, drilling operations, utilization, and reclamation and abandonment) is listed below in Table 4-5.

Drilling Operations

The overall impact of drilling operation activities on wildlife populations at a geothermal project site would depend on the type and amount of wildlife habitat that would be disturbed, the nature of the disturbance (e.g., complete, permanent reduction because of structures or drill pads, or temporary disturbance in construction support areas), and the wildlife that occupy the project site and surrounding areas.

Clearing and grading activities would result in the direct injury or death of wildlife that are not mobile enough to avoid construction operations (e.g., reptiles, small mammals, and young), that use burrows (e.g., ground squirrels and burrowing owls), or that are defending nest sites (e.g., ground-nesting birds). Although more mobile species of wildlife, such as deer and adult birds, may avoid the initial clearing activity by moving into habitats in adjacent areas, it is conservatively assumed that adjacent habitats are at carrying capacity for the species that live there and could not support additional biota from the construction areas. The subsequent competition for resources in adjacent habitats would likely preclude the incorporation of the displaced individual into the resident populations.

Sump pits could impact wildlife species by providing a catch basin for rainwater (an assumed water source). Sump pits often contain high concentrations of minerals and chemicals from the drilling fluids, which can be toxic to wildlife. In addition, smaller species of wildlife may drown in the sump pits, which are often lined with plastic to prevent seepage and vegetation growth, making it difficult for wildlife to escape.

Utilization

Constructing a geothermal project and its ancillary facilities may impact wildlife through the reduction, alteration, or fragmentation of habitat, which represents the greatest impact on wildlife. All existing habitat within the drilling operations footprint, along new access road corridors, and within new utility right-of-ways would be disturbed. The amount of habitat that would be disturbed would be a function of the size of the proposed geothermal project and would range from approximately 53 acres to 367 acres (RFD) for indirect-use projects. Direct-use applications typically would disturb far less habitat, potentially less than one acre. The existing degree of disturbance already present in the project site area would also affect the total disturbed area resulting from geothermal drilling operations. Wildlife and wildlife habitat adjacent to disturbed areas could also be affected. Clearing and grading activities would impact wildlife greater than under the drilling operations phase due to the increased footprint of full build out.

Table 4-5
Impacts on Wildlife and Wildlife Habitat during Full Buildout of a Geothermal Development

Ecological Stressor	Geothermal Activity	Impact	Potential Level of Impact			
			Exploration	Drilling Operations	Utilization	Reclamation and Abandonment
Habitat disturbance	Site clearing and grading; well drilling, construction; pipelines, access road, and ancillary facility construction; construction and maintenance vehicle travel; operational noise	Disruption of breeding, migration, wintering, and foraging behavior	Moderate	Moderate	Moderate to high	Low to moderate
Invasive vegetation	Site clearing and grading; well drilling, construction; pipelines, access road, and ancillary facility construction; construction and maintenance vehicle travel	Reduced habitat quality and species diversity. Alter habitat use for foraging and breeding	Low to moderate	Low to moderate	Moderate to high	Low to moderate
Injury or mortality	Site clearing and grading; well drilling, construction; pipelines, access road, and ancillary facility construction; construction and maintenance vehicle travel	Destruction and injury of wildlife, mostly those with limited mobility	Low to moderate	Low to moderate	Moderate	Low to moderate

Table 4-5
Impacts on Wildlife and Wildlife Habitat during Full Buildout of a Geothermal Development

Ecological Stressor	Geothermal Activity	Impact	Potential Level of Impact			
			Exploration	Drilling Operations	Utilization	Reclamation and Abandonment
Erosion and runoff	Site clearing and grading; well drilling, construction; pipelines, access road, and ancillary facility construction; construction equipment travel	Reduced reproductive success of amphibians using on-site surface waters; drinking water affected. May limit survival of fish eggs and fry, increase predation, and reduce fish survival	Moderate	Moderate	Moderate to high	Moderate
Fire	Site clearing and grading; well drilling, construction; pipelines, access road, and ancillary facility construction; construction and maintenance vehicle travel	Direct injury and mortality, loss of habitat, loss of food source, and loss of cover	Low to moderate	Low to moderate	Moderate	Low
Noise	Site clearing and grading; well drilling, construction; pipelines, access road, and ancillary facility construction; construction and maintenance vehicle travel	Disruption of breeding, migration, wintering, and foraging behavior	Moderate to high	Moderate to high	High	High

Table 4-5
Impacts on Wildlife and Wildlife Habitat during Full Buildout of a Geothermal Development

Ecological Stressor	Geothermal Activity	Impact	Potential Level of Impact			
			Exploration	Drilling Operations	Utilization	Reclamation and Abandonment
Exposure to contaminants	Accidental spill during equipment refueling; accidental release of stored fuel or hazardous materials; drilling mud spill or accidental spill of geothermal fluids and working fluids	Exposure may affect survival, reproduction, development, or growth of fish and wildlife	Low	Low	Low	Low

The assessment of impact level is based on the RFD; and activities and projected disturbance associated with each stage geothermal development, as well evaluation of the efficacy of stipulations and BMPs available to eliminate or mitigate the potential impacts. Duration of the impact as well as potential for accidents factor into the assessment.

Low- The activities involved in geothermal development do not present a risk or have effective precautions, BMPs, and stipulations that would minimize the potential, intensity, and duration of impact associated the prospective ecological risk factor.

Moderate- The activities involved in geothermal development have a greater potential for impacts on wildlife, including accidents, unavoidable removal of habitat, and indirect disturbance. Impacts may be unavoidable and may endure beyond the conclusion of the activity.

High- The activities involved in geothermal activities would have direct and unavoidable impacts. BMPs and stipulations are not available to eliminate impacts. Additionally, the risk of accident may be higher or the duration of the impact may be last well beyond the conclusion of the geothermal activities.

Any effects of habitat reduction, disturbance, or fragmentation on wildlife would be related to the type and abundance of the habitats affected and to the wildlife that occur in those habitats. Large developments (367 acres) could represent a significant impact on local wildlife, especially to species whose affected habitats are uncommon and not well represented in the surrounding landscape. However, smaller projects and geothermal projects on previously disturbed lands or accessible by existing roadways would affect far less habitat.

Noise from drill rigs and construction activities during the utilization phase can disturb wildlife in adjacent habitats up to 2,500 feet away. Noise can cause wildlife to avoid habitats, disrupt behavioral patterns, and potentially cause a long-term decline in wildlife populations.

Wildlife habitat could also be impacted if invasive vegetation becomes established in the construction-disturbed areas and adjacent off-site habitats. The establishment of invasive vegetation could reduce habitat quality for wildlife and could locally affect wildlife occurrence and abundance.

During operations within the geothermal utilization phase, grass mowing and brush cutting may be required once every few years. These activities would result in minor impacts on wildlife. Mobile animals would be displaced to adjacent undisturbed habitats. Less mobile wildlife could be killed or injured during mowing and cutting; however, the overall significance of such impacts on local wildlife populations would likely be minor, because of the likely limited quality and carrying capacity of the maintained habitats.

The presence of a geothermal facility could disrupt movements of terrestrial wildlife, particularly during migration. Herd animals such as elk, deer, and pronghorn antelope could potentially be affected by power plants, pipelines, facilities, or drill pads that are placed along migration paths between winter and summer ranges or in calving areas. The geothermal facility and associated structures and access roads would be maintained as areas of low vegetation that may hinder or prevent movements of some wildlife species.

Increased human activity also increases the potential for fires. Fire may affect wildlife through direct mortality, reduction of habitat, and/or a reduction in habitat quality. In general, short-term and long-term fire effects on wildlife are related to fire impacts on vegetation, which in turn affect habitat quality and quantity, including the availability of forage and cover.

The licensed use of pesticides and herbicides at a geothermal development would not be expected to adversely affect local wildlife. Applications of these materials would be conducted by following label directions and in accordance with applicable permits and licenses. However, accidental spills or releases of these materials could impact exposed wildlife.

Reclamation and Abandonment

The impacts associated with reclamation and abandonment would be similar to those associated with the drilling operations phase but to a lesser extent and for a shorter time period. Reclamation and abandonment activities would include vehicle traffic and structure removal, which would cause noise and may damage adjacent wildlife habitat. Reclamation and abandonment would also increase the potential for runoff and erosion, as lands would be disturbed during the removal of buildings, structures, pipelines, and transmission towers. Once all structures are removed, geothermal wells would be capped, and disturbed areas would be reclaimed with native vegetation to provide habitat for wildlife.

4.10.4 What are the Potential Impacts on Fish and Wildlife Associated with the Proposed Action and Alternatives?

The following discussion analyzes the environmental consequences or impacts expected to occur as a result of anticipated future actions consistent with implementing the alternatives described in Chapter 2.

Impacts under Alternative A

Under the no action alternative, lease applications would continue to be processed on a case-by-case basis. Areas closed to geothermal leasing by statute, regulation, or orders would remain closed, and discretionary closed areas would be assessed based on local land use plans. The number of acres that could impact fish and wildlife is unknown; however, impacts would be site-specific and similar to the impacts under the four phases of geothermal development identified under Section 4.10.3. Under this alternative, no comprehensive list of stipulations, best management practices, or procedures would be distributed to serve as consistent guidance for all future geothermal leasing and development for direct and indirect use. This would result in fragmented and segregated planning for wildlife and wildlife habitats which often exponentially increases impacts. Development of the individual leasing approvals, stipulations, and mitigation levels would also continue to vary per site and delay application processing time.

Impacts under Alternative B

Under this alternative, the land closed to geothermal leasing for direct and indirect use would increase. The BLM and FS would close approximately 25,150,000 acres of public land and 24,370,000 acres of NFS lands to geothermal leasing that are incompatible with geothermal leasing, exploration, and development.

These closed lands would protect wildlife and wildlife habitats from potential development. Wildlife in closed areas would not be affected by geothermal development. This alternative would have fewer impacts on fish and wildlife and their habitats, specifically in important wildlife habitats such as roadless areas, wilderness areas, and areas of critical environmental concern, than Alternative A.

Under this alternative, the BLM and FS would issue a comprehensive list of stipulations, best management practices, and procedures to serve as consistent guidance for future geothermal leasing for direct and indirect use. Relevant stipulations (Section 2.2.2) designed to minimize impacts on fish and wildlife include (1) no surface occupancy on water bodies, riparian areas, and wetlands; (2) controlled surface use in areas that would adversely impact the continuity of migration corridors or important habitat; and 3) controlled surface use within 500 feet of riparian or wetland vegetation to protect the values and functions of these areas. In accordance with BMPs (Appendix D), operators would review existing information on species and habitats in the vicinity of the project area to identify potential concerns. Operators would also employ timing restrictions and design features (outlined in the BMPs in Appendix D) to avoid, minimize, or mitigate negative impacts on vulnerable fish and wildlife while maintaining or enhancing habitat values for other species. It is expected that these measures would effectively minimize impacts on fish and wildlife by protecting and maintaining key habitats, reducing habitat fragmentation, reducing human caused disturbance to species and habitats, managing for invasive/weed species, and promoting the enhancement and/or restoration of existing habitat conditions when appropriate.

Impacts under Alternative C

Under this alternative, approximately 61,200,000 acres of public land and 37,900,000 acres of NFS lands within 10 miles of the centerline of existing transmission lines and at least 15 miles outside of the Yellowstone National Park boundary would be open to leasing for indirect use subject to major and moderate constraints as detailed in the Chapter 2. About 81,951,000 acres of public land and 65,712,000 acres of NFS lands would be closed to leasing for indirect use.

There would be less land available for exploration and development of geothermal resources for indirect use than under Alternatives A or B.

Under this alternative, there would be less impact on fish and wildlife and their habitats than the other alternatives, as large areas would be closed to leasing for indirect use. Lands open to leasing within the corridors would be subject to constraints that are intended to protect wildlife and wildlife habitats.

Additionally, lands that contain existing transmission lines often have existing access and maintenance roads constructed that could potentially be used during geothermal development, further limiting the potential impacts on fish and wildlife species.

Areas open to direct use geothermal lease applications and impacts from their subsequent development would be the same as identified under Alternative B.

4.11 THREATENED AND ENDANGERED SPECIES AND SPECIAL STATUS SPECIES

4.11.1 What did the Public Say about Impacts on Threatened and Endangered and Special Status Species?

Comments collected during scoping relating to threatened and endangered and special status species addressed a general concern for all special status species and requested that impacts on special status species be addressed. Concerns related to special status species found in sagebrush habitats and the potential impacts resulting from geothermal development were included in public comments. Comments also addressed the need to provide adequate analysis related to loss and fragmentation of habitat and requested that measures be included to protect special status species potentially affected by geothermal projects. Concerns related to how geothermal development might affect several specific species were expressed.

4.11.2 How Were the Potential Effects of Geothermal Development on Threatened and Endangered and Special Status Species Evaluated?

Potential impacts on threatened and endangered and special status species could occur if reasonably foreseeable future actions were to result in the following:

- Violate the ESA, Bald and Golden Eagle Protection Act, MBTA, or applicable state laws; or
- Adversely affect any individual or population of federally listed species.

4.11.3 What are the Common Impacts on Threatened and Endangered and Special Status Species Associated with Geothermal Development?

Due to the inability to predict future development scenarios, including types of development, timing, and location, the following impact analysis provides a general description of common impacts on threatened and endangered and special status species from geothermal resource development.

The Reasonable Foreseeable Development Scenario for Threatened and Endangered and Special Status Species

Geothermal exploration, drilling operations, utilization, and reclamation and abandonment could affect threatened, endangered, and sensitive species in the same manner that vegetation, wildlife, and aquatic resources could be affected (see Section 4.10, Fish and Wildlife). Threatened and endangered species, including federal and state-listed species and BLM and FS special status species, could be affected as a result of 1) habitat disturbance, 2) the introduction of invasive vegetation, 3) injury or mortality, 4) erosion and runoff, 5) fugitive dust, 6) noise, 7) exposure to contaminants, and 8) interference with behavioral activities. Which species may be at risk to construction-related effects would depend on the ecoregion in which the project is located (Figure 3-11) and the specific habitat present at or near the site. An important distinction regarding impacts on special status species is that impacts on small localized areas or affecting only a few individuals can have adverse impacts on special status species. Many special status species are dependent on unique habitats or have small remaining populations. Impacts that directly affect these unique habitats or individuals, even when small, can have significant impacts on special status species.

Impacts on threatened, endangered, and sensitive wildlife species could include injury or mortality or could involve reduction or fragmentation of habitat, reduction or displacement of habitat features such as cover and forage, exposure to contaminants (e.g., diesel fuel or geothermal working fluid) from a spill, and destruction of individual biota (e.g., from drilling and clearing activities or from vehicle collisions). Because of the regulatory requirements of the ESA and various state regulations, and the requirements specified in BLM Manual 6840 Special Status Species Management and other resource-specific regulations and guidelines, appropriate survey, avoidance measures would be identified and implemented prior to any geothermal activities to avoid adversely affecting any sensitive species or the habitats on which they rely.

4.11.4 What are the Potential Impacts on Threatened and Endangered and Special Status Species Associated with the Proposed Action and Alternatives?

The following discussion analyzes the environmental consequences or impacts expected to occur as a result of anticipated future actions consistent with implementing the alternatives described in Chapter 2.

Impacts under Alternative A

Under the no action alternative, lease applications would continue to be processed on a case-by-case basis. Areas closed to geothermal leasing by statute, regulation, or orders would remain closed, and discretionary closed areas would be assessed based on local land use plans. The number of acres that could impact threatened, endangered, and special status species is unknown; however, impacts would be site specific and similar to the impacts under the four phases of geothermal development identified under Section 4.11.3. Under this alternative, no comprehensive list of stipulations, best management practices, or procedures would be distributed to serve as consistent guidance for all future geothermal leasing and development for direct and indirect use. This would result in fragmented and segregated planning for threatened, endangered, and special status species, which often exponentially increases impacts. Development of the individual leasing approvals, stipulations, and best management practices would also continue to vary per site and delay application processing time. Section 7 consultation under the ESA would be required under this and all alternatives and is meant to limit potential impacts on listed species and their habitat.

Impacts under Alternative B

Anticipated future actions taken consistent with implementing Alternative B would impact threatened, endangered, and special status species less than Alternative A. Under this alternative, the land closed to geothermal leasing for direct and indirect uses would increase. The BLM and FS would close approximately 25,150,000 acres of public land and 24,370,000 acres of NFS land to geothermal leasing for direct and indirect use that are incompatible with geothermal leasing, exploration, and development. Lands closed to leasing would protect special status species and their habitat. Many of the areas that would be closed for leasing include high-value habitats for many special status species such as old growth forests and wetland and riparian areas.

Under this alternative, the BLM and FS would issue a comprehensive list of stipulations, best management practices, and procedures to serve as consistent guidance for future geothermal leasing for direct and indirect use. Relevant stipulations (Section 2.2.2) designed to minimize impacts on Threatened and Endangered Species and Special Status Species include no surface occupancy for designated or proposed critical habitat for listed species under the Endangered Species Act (ESA) of 1973 (as amended) if it would adversely modify the habitat. For listed or proposed species without designated habitat, no surface occupancy would be implemented to the extent necessary to avoid jeopardy. Lease stipulations would also be included that limit disturbance or activities to specific seasonal or temporal time frames that are meant to protect Threatened or Endangered Species and Special Status Species. These stipulations are routinely used to protect breeding, nesting, and wintering behaviors that are critical for survival. Section 7 consultation under the ESA would be required under this and all alternatives and is meant to minimize potential impacts on ESA-listed species and their habitat. For agency designated sensitive species (e.g. sage grouse), lease stipulations would be imposed for those portions of high value species habitat where other existing measures are inadequate to meet agency management objectives. It is expected that these measures would effectively minimize impacts on Threatened and Endangered Species and Special Status Species by maintaining habitats necessary for the survival and recovery of these species; minimizing human caused habitat destruction, degradation and fragmentation; and minimizing human interaction with these species at critical times and locations.

Impacts under Alternative C

Under this alternative, approximately 61,200,000 acres of public land and 37,900,000 acres of NFS lands within the corridor would be open to leasing for indirect use and subject to major and moderate constraints, as detailed in Chapter 2. About 81,951,000 acres of public land and 65,712,000 acres of NFS land would be closed to leasing for indirect use.

Under this alternative there would be less potential for impacts on threatened and endangered and special status species than the other alternatives, as large areas would be closed to leasing for indirect use, many of them important habitat areas for these species. Lands open to leasing within 10 miles of the centerline of existing transmission lines and at least 15 miles outside of the Yellowstone National Park boundary would be subject to major and minor constraints meant to protect specific resources, including threatened, endangered, and special status species. A major constraint of no surface occupancy or no ground disturbance would be placed on areas adjacent to potential habitat for threatened, endangered, and special status species and areas of high value for these species.

Under this alternative, lease stipulations may also be included that limit disturbance or activities to specific seasonal or temporal time frames that are meant to protect special status species. These stipulations are routinely used to protect breeding, nesting, and wintering behaviors that are critical for survival.

Additionally, those lands leased for indirect use of geothermal resources within existing transmission corridors often have existing access and maintenance roads constructed that could potentially be used for geothermal development, further limiting the potential impacts on special status species. Section 7 consultation under the ESA would be required under this and all alternatives and is meant to limit potential impacts on listed species and there habitat.

Areas open to direct use geothermal lease applications and impacts from their anticipated subsequent development would be the same as identified under Alternative B.

4.12 WILD HORSES AND BURROS

4.12.1 What did the Public Say about Impacts on Wild Horses and Burro?

No public comments were received regarding impacts on wild horses or burros.

4.12.2 How Were the Potential Effects of Geothermal Development on Wild Horses and Burros Evaluated?

Impacts on wild horses and burros were evaluated by: 1) considering the acreages of herd areas and herd management areas contained within the planning area; 2) considering the types of impacts that geothermal projects may have on wild horse and burro populations; and 3) describing both the impacts and the relative land areas that could be impacted by anticipated future actions consistent with the three alternatives described in Chapter 2.

Potential impacts on wild horses and burros could occur if reasonably foreseeable future actions were to result in the following:

- Conflict with management goals and objectives set forth by the BLM for protecting and managing wild horses and burros; or
- Interfere with the movement of wild horses and burros.

4.12.3 What are the Common Impacts on Wild Horses and Burros Associated with Geothermal Development?

Due to the inability to predict future development scenarios, including types of development, timing, and location, the following impact analysis provides a general description of common impacts on wild horses and burros from geothermal resource development. Issuing geothermal leases would not disturb wild horse and burro populations or habitat, so the discussion is limited to impacts related to anticipated future actions.

The Reasonable Foreseeable Development Scenario for Wild Horses and Burros

According to the RFDs, it is estimated that 111 power plants could be constructed by 2015, and another 133 power plants could be constructed by 2025. For direct use, it is estimated that by 2015, applications could be developed in the amount of 1,600 thermal megawatts and by 2025, applications could be developed in the amount of 4,200 thermal megawatts. For indirect use, the RFD scenario estimates that up to 40,737 acres of land would be disturbed by 2015, and up to 89,548 acres of land would be disturbed by 2025. Wild horse and burro populations are found on public lands in 10 of the 12 western states included in the planning area. Population numbers and acreages of herd areas and herd management areas vary by state (see Table 3-25 Project Area Wild Horse and Burro Statistics).

Exploration

Activities and noise associated with exploration could alter wild horse and burro travel routes and grazing grounds. Surveying activities could alter migration routes if additional roads or routes are developed to survey potential geothermal sites and if fence construction blocks travel paths. Additional roads would improve human access to previously inaccessible areas, creating potential for habitat degradation. Noise from vehicles and drilling could disrupt grazing activities and encourage change in travel routes if animals react by avoidance. The magnitude and extend of the impact would depend on current land use in the area.

Drilling Operations

Impacts on wild horses and burros during the drilling operations phase could include noise disturbance and the alteration of travel routes and grazing grounds, as described above for exploration. Additional long-term impacts could result from installing additional access roads, production wells, injections wells, and sump pits. Sump pits could impact wild horses and burros by providing a catch basin for rainwater (an assumed water source). Sump pits often contain high concentrations of minerals and chemicals from the drilling fluids, which can be toxic to wild horses and burros. Acreage dedicated to well pads and needed equipment would reduce habitat. Pipelines placed aboveground could pose minimal-to-moderate obstacles in migration, depending on placement and size.

Utilization

Additional long-term impacts could result from installing added access roads, power lines, and other utilities needed for power plants and direct use facilities. Acreage dedicated to well pads and needed equipment would reduce habitat. Pipelines placed above ground could pose minimal-to-moderate obstacles in migration, depending on placement and size.

Noise disturbance from standard operation and maintenance activities would occur. No additional impacts would be recognized during this phase unless an additional drill site is required. Impacts from additional drill sites would be the same as those impacts discussed above under the drilling operations phase.

Reclamation and Abandonment

Impacts on wild horses and burros from reclamation and abandonment activities would be limited to noise disturbance, as described above under exploration. All disturbed lands would be reclaimed in accordance with BLM standards and would be made available as habitat unless otherwise planned.

4.12.4 What are the Potential Impacts on Wild Horses and Burros Associated with the Proposed Action and Alternatives?

The following discussion analyzes the environmental consequences or impacts expected to occur as a result of anticipated future actions consistent with implementing the alternatives described in Chapter 2. In the absence of site-specific data, including site location and timing, impacts on wild horses and burros would vary by lease area.

Under Alternative B, the potential area open for geothermal leasing is 197 million acres of public and NFS lands. Approximately 45 percent of wild horse and burro Herd Management Area lands occur within the potential area. Under Alternative C, even fewer Herd Management Area lands (approximately 30 percent of wild horse and burro Herd Management Area lands) occur on lands open to geothermal leasing, further narrowing the scope of the analysis.

Impacts under Alternative A

Under the no action alternative, lease applications would continue to be processed on a case-by-case basis. Areas closed to geothermal leasing by statute, regulation, or orders would remain closed, and discretionary closed areas would be assessed based on local land use plans. The acreage used by wild horses and burros and likely to be affected under this alternative is unknown.

Impacts on wild horses and burros could occur during the exploration, drilling operations, and utilization phases. By not designating geothermal potential areas as open or closed, individual geothermal projects could be developed in a number of locations, each resulting in various long- and short-term impacts on wild horse and burro populations. Under this alternative, no comprehensive list of stipulations, best management practices, or procedures would be distributed to serve as consistent guidance for future geothermal leasing and development for direct and indirect uses. This could result in inconsistent planning on lands designated as herd areas and herd management areas. Due to the uncertainty of lands considered for direct and indirect use geothermal leasing and development under this alternative, it is not possible to quantify the total habitat acreage or number of animals that would be affected on Federal lands.

The Wild Free-Roaming Horses and Burros Act of 1971 dictates that one responsibility of the BLM is to protect, manage, and control wild horses and burros. As such, additional stipulations and mitigation measures may be applied on a case-by-case basis to leases where direct and indirect use geothermal resource development will impact these species.

Impacts under Alternative B

Under Alternative B, geothermal leasing for direct and indirect use would be open on approximately 197 million acres. Lands identified as open for geothermal leasing for direct and indirect use could be open with moderate to major constraints, depending on environmental conditions identified during site-specific reviews conducted by field offices prior to issuing the leases. Approximately 45 percent of wild horse and burro Herd Management Area land in the project area would be open for geothermal leasing for direct and indirect use.

Under this alternative, the BLM and FS would issue a comprehensive list of stipulations, best management practices, and procedures to serve as consistent guidance for future geothermal leasing for direct and indirect use. In accordance with BMPs (Appendix D), employees, contractors, and site visitors would be instructed to avoid harassment and disturbance of wild horses and burros during reproductive (e.g., breeding and birthing) seasons. Observations of potential problems regarding wild horses or burros would be reported to the authorized officer immediately. As described under the no action alternative, additional stipulations and mitigation measures may be applied on a case-by-case basis by the BLM if wild horses or burros are present within the proposed leasing area. Stipulations and mitigation measures could include requiring a habitat restoration plan to avoid (if possible), minimize, or mitigate negative impacts. It is expected that these measures would effectively avoid or minimize impacts on wild horses and burros by avoiding human interaction with wild horses and burros at key times and locations and minimizing habitat impacts.

Impacts under Alternative C

Under Alternative C, geothermal leasing for indirect use would be open on approximately 99 million acres. All federal lands identified as open to geothermal leasing for indirect use under this alternative are within 10 miles of the centerline of existing transmission lines. Restricting the placement of geothermal resource development for indirect use to within 10 miles of the centerline of existing transmission lines and at least 15 miles outside of the Yellowstone National Park boundary would minimize impacts on wild horse and burro populations by concentrating land uses associated with energy development into designated areas and limiting opportunity for development in herd areas and herd management areas.

Areas open to geothermal lease applications for direct use and impacts from their anticipated subsequent development would be the same as identified under Alternative B.

4.13 LIVESTOCK GRAZING

4.13.1 What did the Public Say about Impacts on Livestock Grazing?

No public comments specifically addressed impacts on livestock grazing on public or NFS lands from the proposed action. The US EPA requested that the EIS identify and analyze areas with potential use conflicts, in which livestock grazing would be included.

4.13.2 How Were the Potential Effects of Geothermal Development on Livestock Grazing Evaluated?

Potential impacts on livestock grazing could occur if reasonably foreseeable future actions were to result in the following:

- Decrease acreages available to grazing;
- Decrease AUM number or forage; or
- Cause harassment or death of livestock.

4.13.3 What are the Common Impacts on Livestock Grazing Associated with Geothermal Development?

Due to the inability to predict future development scenarios, including types of development, timing, and location, the following impact analysis provides a general description of common impacts on livestock grazing from geothermal resource development. Issuing leases would not impact livestock grazing operations on federal lands, so the discussion focuses on impacts related to anticipated future actions following leasing.

The Reasonable Foreseeable Development Scenario for Land Use

The four phases of geothermal development involve different levels of geothermal activity. The varying levels of geothermal activity influence the level of impact on livestock grazing. Direct and indirect use of geothermal resources would have similar impacts.

Exploration

Geothermal exploration affects large areas of grazing in the short term during temporary construction of well pads, exploration wells, and roads. Impacts would include loss of forage, reduced forage palatability because of dust on vegetation, and displacement of livestock from construction noise. Additional roads could also impact livestock by opening up areas that were not previously accessible, thereby increasing disturbance or harassment of livestock. However, creating new access roads to areas where livestock graze would help livestock operators manage their stock more efficiently.

Drilling Operations

Geothermal drilling operations affect larger areas of grazing in the longer term during construction of additional production wells, injection wells, and sump pits after exploration.

Sump pits could impact livestock grazing by providing a catch basin for rainwater (an assumed water source). Sump pits often contain high concentrations of minerals and chemicals from the drilling fluids, which can be toxic to grazing animals.

Utilization

Impacts during initial construction within the utilization phase are similar to but greater than the drilling operations phase and include loss of forage, reduced forage palatability because of dust on vegetation, restriction of livestock movement from pipelines and protective fencing surrounding the development area, harassment of livestock from additional access to livestock grazing areas, and temporary displacement of livestock from construction noise.

In the long term, a smaller amount of permanent grazing acreage is lost during geothermal operation than under the exploration, drilling operations, or initial construction during the utilization phases. No new construction would take place, as the project footprint would already be designated. Impacts would be similar to but less than the impacts identified under drilling operations, above. The length of time that impacts would occur depends on the availability of the geothermal resource itself.

Reclamation and Abandonment

Impacts on livestock grazing during the reclamation and abandonment phase would be short term and limited to the footprint of developed areas. Impacts would include increased noise and dust from demolition of existing pipelines and facilities. In the long term, restored vegetation would provide forage for grazing that was originally lost in development.

4.13.4 What are the Potential Impacts on Livestock Grazing Associated with the Proposed Action and Alternatives?

The following discussion analyzes the environmental consequences or impacts expected to occur as a result of anticipated future actions consistent with implementing the alternatives described in Chapter 2.

Impacts under Alternative A

Under the no action alternative, lease applications would continue to be processed on a case-by-case basis. Areas closed to geothermal leasing by statute, regulation, or orders would remain closed, and discretionary closed areas would be assessed based on local land use plans. The number of acres that could impact livestock grazing practices is unknown; however, impacts would be site-specific and similar to the impacts under the four phases of geothermal development identified under Section 4.13.3. Under this alternative, no comprehensive list of stipulations, best management practices, or procedures would be distributed to serve as consistent guidance for all future geothermal leasing and development for direct and indirect use. Development of the individual leasing approvals, stipulations, and best management practices would continue to vary per site and delay application processing time. Depending on the constraints identified by the leasing officer and identified within existing land use plans, areas identified as open or closed to leasing for direct and indirect use could create or take away conflicts that might result between grazing and geothermal development practices (such as harassment of livestock and other impacts identified under Section 4.13.3, above). It is important to note that some land use plans may be outdated and may not address geothermal leasing or development for direct or indirect use.

Impacts under Alternative B

Under Alternative B, planning area lands within grazing allotments would be identified as open or closed to geothermal leasing for direct and indirect use (See Table 4-6). Approximately 82 percent of available grazing allotments within public lands would be open to geothermal leasing for direct and indirect use, and approximately 95 percent of available grazing allotments within NFS lands would be open to geothermal leasing for direct and indirect use under Alternative B.

Table 4-6
Acreages of Grazing Allotments Open and Closed to Geothermal Leasing within the Planning Area under Alternative B

	Acres of Grazing Allotments on Public Lands	Acres of Grazing Allotments on NFS lands
Open to Leasing (Direct and Indirect Use)	102,179,879	66,455,039
Closed to Leasing (Direct and Indirect Use)	22,951,428	3,732,254
Total	125,131,307	70,187,293

Under this alternative, the BLM and FS would issue a comprehensive list of stipulations, best management practices, and procedures to serve as consistent guidance for future geothermal leasing for direct and indirect use. In accordance with BMPs (Appendix D), operators would employ dust control measures to reduce impacts on livestock forage during construction and demolition. Litter and noxious weeds would be controlled and removed regularly during construction and operation. BMPs would also require that geothermal development be designed to minimize the number of structures. In addition geothermal companies should work with livestock permittees to mitigate impacts on water by producing off-site water developments. If appropriate, produced water from geothermal operations could be made available to livestock for use if water quality were sufficient. This additional water could increase livestock distribution and available forage for livestock that would otherwise be lost to development. It is expected that these measures would effectively minimize impacts on livestock grazing by reducing impacts on forage.

Impacts under Alternative C

Under Alternative C, impacts on grazing are analyzed within areas open to leasing for indirect use within 10 miles of the centerline of existing transmission lines. Approximately 43 percent of available grazing allotments within public lands would be open to geothermal leasing for indirect use, and approximately 40 percent of available grazing allotments within NFS lands would be open to geothermal leasing for indirect use under Alternative C (see Table 4-7). Impacts within 10 miles of the centerline of existing transmission lines and at least 15 miles outside of the Yellowstone National Park boundary would be similar to Alternative B, but less area would be designated as open to geothermal leasing for direct use, and potential impacts from geothermal operations would be decreased and centralized to already disturbed transmission line areas. Areas open to direct use geothermal lease applications and impacts from their subsequent development would be the same as identified under Alternative B (see Tables 4-6 and 4-7).

Table 4-7
Acreages of Grazing Allotments Open and Closed to Geothermal Leasing under Alternative C

	Acres of Grazing Allotments on Public Lands	Acres of Grazing Allotments on NFS Lands
Open to Leasing for Indirect Use	53,772,871	28,120,522
Closed to Leasing for Indirect Use	71,358,436	42,066,771
Total	125,131,307	70,187,293
Open to Leasing for Direct Use	102,179,879	66,455,039
Closed to Leasing for Direct Use	22,951,428	3,732,254
Total	125,131,307	70,187,293

4.14 CULTURAL RESOURCES

4.14.1 What did the Public Say about Impacts on Cultural Resources?

Several comments from agencies and the public specifically addressed cultural resources. These are summarized below.

- The Idaho Conservation League and Utah Environmental Congress requested that the PEIS examine direct and cumulative impacts resulting from reasonably foreseeable geothermal development on sensitive historical or cultural resources, including sites eligible for the National Register of Historic Places and Native American respected sites and their settings (which encompass the viewsheds visible from the site).
- The Save Medicine Lake Coalition stated that the National Forests' timber stands, clean air, pure waters, cultural sites, and wildlife habitats cannot continue to be torn apart and put in harm's way by experimental or inexact geothermal technology.
- The Wilderness Society and Western Resource Advocates provided the following comments:
  - The agencies should specifically outline the environmental issues this PEIS will analyze in detail and include archaeological, cultural, or historic resources in the analysis. Should the agencies decide not to analyze any of these issues in detail, they should provide a detailed explanation of the grounds for not considering these issues, including how a failure to analyze them is not a violation of NEPA.
  - For both the setting of cultural resources and the enjoyment of recreation opportunities, the PEIS should consider preserving the scenic values associated with these areas.
  - The PEIS should acknowledge the likelihood of the presence of cultural resources and sacred sites in areas with geothermal energy potential and commit to both a Class III inventory and proactive consultation prior to leasing an area or permitting development.
  - The PEIS should include a commitment not to permit leasing or siting of geothermal energy projects in or immediately adjacent to areas with important cultural and archaeological resources.
- Ormat, Inc. stated that the PEIS should analyze exploration impacts, including analyzing at least three well pads for each of the resources considered. The effects of well drilling and testing are well known. The analysis of exploration drilling should be included and covered in the PEIS such that the lessee would only need to conduct site-specific cultural and season-appropriate biological surveys and

implement standard mitigation measures in order to construct the well pad and drill and test the wells.

- The US EPA stated that when identifying the areas of moderate to high potential for geothermal resources, the PEIS should also identify environmentally sensitive areas and areas with potential use conflict, including areas that are affiliated with Native American tribes, historic properties, Native American sacred sites or sensitive areas, and cultural resources. The scope of impacts on cultural resources should include the direct, indirect, and cumulative impacts on historic properties, districts, or landscapes.
- Individuals offered the following comments:
  - Consideration must be given to protecting outstanding historic, recreational, and biological resources that might be impacted. The PEIS should consider these impacts and should develop alternatives that would protect each of these resources.
  - With respect to the PEIS, information on potential cultural sites and issues should be included.

4.14.2 How Were the Potential Effects of Geothermal Development on Cultural Resources Evaluated?

This section addresses impacts on prehistoric and historic archaeological sites, structures, and buildings only. Native American Traditional Cultural Properties, sacred sites, and other concerns are addressed in Section 4.15, Tribal Interests and Traditional Cultural Resources. Historic trails are addressed under Section 4.16, National Scenic and Historic Trails. Consultations on programmatic actions including allocating areas as open or closed to leasing and determining lease stipulations are ongoing. These allocations do not grant any rights or authorize any activities affecting cultural resources. Impact analysis focuses on the anticipated future actions consistent with the implementation of the alternatives described in Chapter 2.

Methods

The authorized surface administrative unit of the BLM or FS would consult with Tribes and State Historic Preservation Officers regarding historic and cultural resources per Section 106 of the National Historical Preservation Act. The presence of archaeological sites and historic properties in the lease area would be determined on the basis of a records search of recorded sites and properties in the area and, depending on the extent and reliability of existing information, an archaeological survey. Archaeological sites and historic properties present in the leasing area would be reviewed to determine whether they meet the criteria of eligibility for listing on the National Register of Historic Places. Additional specific consultation requirements would be determined on a project-by-project level and during the ADP process.

Impact Criteria
Potential impacts on cultural resources could occur if reasonably foreseeable future actions were to:

- Conflict with management goals and objectives set forth by the BLM or FS in order to sustain cultural resources and their qualities;
- Result in proposed uses that are incompatible with maintaining and identifying cultural resources and their qualities; or
- Have an adverse affect on historic properties under Section 106 of the National Historic Preservation Act (36 CFR 800).

Assumptions
The PEIS includes standard NSO/NGD stipulations to protect cultural resources. An authorizing officer could grant exemptions to these stipulations on a case-by-case basis after determining that NSO/NGD is not warranted to achieve resource protection. Additional NSO/NGD stipulations could be applied by the authorizing officer to address specific location resource concerns. The following areas would have NSO/NGD stipulations:

- Within the setting of National Register eligible sites, including traditional cultural properties, where setting is critical to their eligibility; and
- Areas with important cultural and archaeological resources, including Native American sacred sites.

4.14.3 What are the Common Impacts on Cultural Resources Associated with Geothermal Development?

Due to the inability to predict future development scenarios, including types of development, timing, and location, the following impact analysis provides a general description of common impacts on cultural resources from geothermal resource development.

The Reasonable Foreseeable Development Scenario for Cultural Resources
According to the RFD scenario, it is estimated that 111 power plants could be constructed by 2015, and another 133 power plants could be constructed by 2025. A representative amount of disturbance for one plant is 53 to 367 acres. Land directly disturbed in the project area would be approximately 5,883 acres to 40,737 acres by 2015 and 12,932 acres to 89,548 acres by 2025. The impacts of each phase of development are discussed below.

Exploration
The exploration phase includes surveying and drilling temperature gradient wells. Surveying activities would impact cultural resources if additional roads or routes are developed across or within a resource's historic landscape in order

to survey the potential geothermal sites. Additional roads could lead to increased disturbances within a resource's boundaries or within a resource's historic landscape, possibly leading to increased illegal collecting and vandalism. The magnitude and extent of the impact would depend on the current state of the resources and their eligibility for the National Register of Historic Places. Any permanent construction or ground disturbances within a resource's boundaries or within its historic landscape would be long-term impacts.

The magnitude and extent of impacts on cultural resources from drilling temperature gradient wells would depend on the current condition of the resources and their eligibility for the National Register of Historic Places. Similar to surveying activities, roads would be required to access wells, and impacts would be similar to those described above for surveying. Several wells could be drilled per lease, and drill sites could disturb approximately 0.9 acres. Impacts would occur on lands directly under the well sites. If wells and appurtenances are constructed within the boundaries of an archaeological site or within its historic landscape, impacts would be long term. If wells and appurtenances are constructed within the boundaries of building or structural resources or their historic landscape, impacts would be considered short term if the modern construction is temporary and long term if the modern construction is permanent.

Drilling Operations

Geothermal drilling operations would result in long-term impacts on cultural resources if allowed within the boundaries of an archaeological deposit or its historic landscape. If new construction would be removed during reclamation and abandonment, impacts from the drilling operations phase on historic buildings or structures would be limited to the period of operation. The drilling operations phase would require access roads to accommodate larger equipment. New roads would have similar impacts to those identified during the exploration phase.

The drilling operations phase includes drill site development, which on average would require ground disturbance within a two-acre area plus a buffer to accommodate additional production wells, injection wells, and fluid sump pits. Any cultural resources or historic landscapes of cultural resources would be directly impacted by the ground disturbance.

Utilization

A power plant would require ground disturbance over approximately 15 to 25 acres and would impact any cultural resources within that area. The new power plant itself would represent a large modern development on a historic landscape. Installing electrical transmission lines from the power plant would disturb approximately one acre per mile of transmission line. Ground disturbance from the transmission line towers would impact cultural resources within their footprint and adjacent areas. Similar to the power plant, the towers and lines themselves could represent a large modern development on a historic landscape. Where feasible, pipelines would parallel access roads and existing roads, which presumably would have already disturbed cultural resources within proximity. However, if the existing road was designed to avoid cultural resources, a new pipeline may impact a previously undisturbed cultural resource. Long-term impacts on cultural resources would result from constructing these modern developments within the boundaries of archaeological sites. If the modern developments were within the viewshed of historic structures and buildings, impacts on those cultural resources would be long term if the developments would remain after closeout and short term if they would be removed.

Reclamation and Abandonment

Reclamation and abandonment activities include abandoning the well after production ceases and reclaiming all disturbed areas. All disturbed lands would be reclaimed in accordance with BLM and FS standards. Impacts on archaeological sites from previous phases would remain, and additional impacts could occur if reclamation and abandonment activities extend beyond previously disturbed areas. Unless the development and changes from exploration, drilling operations, and utilization phases are removed and the preexisting conditions are reestablished, all impacts on historic buildings and structures from previous phases would continue as well.

4.14.4 What are the Potential Impacts on Cultural Resources Associated with the Proposed Action and Alternatives?

The following discussion analyzes the environmental consequences or impacts expected to occur as a result of anticipated future actions consistent with implementing the alternatives described in Chapter 2. In the absence of site-specific data, including site location, only a general analysis of impacts on cultural resources is possible at this time. Under all alternatives, the NSO/NGD stipulations described in 4.14.2 would be applied.

Impacts under Alternative A

Under the no action alternative, lease applications would continue to be processed on a case-by-case basis. Areas closed to geothermal leasing by statute, regulation, or orders would remain closed, and discretionary closed areas would be assessed based on local land use plans. The number of acres likely to be affected under this alternative is unknown.

Issuing geothermal leases for direct and indirect use on a case-by-base basis is not expected to affect cultural resources. The case-specific studies required prior to issuance of a lease would be expected to prevent impacts on cultural resources. Under this alternative, however, no comprehensive list of stipulations, best management practices, or procedures would be distributed to serve as consistent guidance for future geothermal leasing and development and protection of cultural resources. This would result in fragmented and segregated planning for preventing impacts, which often exponentially increases recognized environmental impacts. Due to the uncertainty of total acreage considered for geothermal leasing and development under this alternative, it is not possible to quantify the total acreage affected on federal lands.

Impacts under Alternative B

Under Alternative B, geothermal leasing for direct and indirect use would be closed on 25,150,000 acres of public land and on 24,370,000 acres of NFS land, protecting cultural resources in those areas. In areas identified as open to leasing for direct and indirect use, impacts would be concentrated in those areas identified in Section 3.14 as containing cultural resources. States identified in the RFD as having the majority of development, including California, Idaho, Nevada, and Oregon, would be expected to incur the greatest cultural resource impacts from direct and indirect geothermal uses.

Under this alternative, the BLM and FS would issue a comprehensive list of stipulations, best management practices, and procedures to serve as consistent guidance for future geothermal leasing for direct and indirect use. Relevant stipulations (Section 2.2.2) designed to minimize impacts on cultural resources include no surface occupancy within the setting and boundary of properties designated or eligible for the National Register of Historic Places, including National Landmarks and National Register Districts and Sites; and additional lands outside the designated boundaries to the extent necessary to protect values where the setting and integrity is critical to their designation or eligibility. Under the proposed leasing procedures (Section 2.2.2), the authorized officer of the BLM or FS would be required to consult with the appropriate Native American Tribes, Alaska Natives, and State Historic Preservation Officers regarding historic and cultural resources per Section 106 of the National Historical Preservation Act prior to leasing. The presence of archaeological sites and historic properties would be determined on the basis of a records search and literature review of recorded sites and properties in the proposed lease area and a buffer around the lease area, if appropriate. Additional historical, cultural or ethnographic research, consultation and/or inventories may be required to identify resources, determine effects, mitigate adverse effects and complete the Section 106 process.

In accordance with BMPs (Appendix D), if cultural resources are present at the site, or if areas with a high potential to contain cultural material have been identified, a cultural resource management plan would be developed that identifies appropriate monitoring and protection measures. Unexpected discovery of cultural resources during geothermal development would be brought to the attention of the responsible BLM authorized office immediately and work shall be halted in the vicinity of the finds to avoid further disturbance while the finds are evaluated and appropriate mitigation measures are developed. It is expected that these measures would effectively avoid and/or minimize impacts on cultural resources by identifying, preserving and protecting significant cultural resources, districts and landscapes; and maintaining viewshed of important cultural resources as appropriate; and reducing indirect impacts from land uses on cultural resources.

Impacts under Alternative C

Under Alternative C, geothermal leasing would be closed to indirect use on 81,951,000 acres of public land and on 65,712,000 acres of NFS land, protecting cultural resources in those areas. This would protect cultural resources on greater acres than under Alternative B. Impacts on cultural resources within the 99,073,000 acres that would remain open to leasing for indirect use would be similar to those described under Alternative B, although the area of impact would be less.

Areas open to direct use geothermal lease applications and impacts from their anticipated subsequent development would be the same as identified under Alternative B.

4.15 TRIBAL INTERESTS AND TRADITIONAL CULTURAL RESOURCES

4.15.1 What did the Public Say about Impacts on Tribal Interests and Traditional Cultural Resources?

Several general comments were made regarding avoiding sensitive areas, cultural resources, heritage resources, and sites eligible for the National Register of Historic Places.

The Idaho Conservation League and Utah Environmental Congress requested that the PEIS specifically address impacts on "... *Native American respected (sic) sites, and their settings."*

The Wilderness Society and Western Resource Advocates advised that *"...hot springs are often the sites for important cultural resources, while also serving as popular recreation areas. For both the setting of cultural resources and the enjoyment of recreational opportunities, preserving the scenic values associated with these areas must be considered. ...The PEIS should acknowledge the likelihood of the presence of cultural resources and sacred sites in areas with geothermal energy potential and commit to both a Class III inventory and proactive consultation prior to leasing an area or permitting development."*

In extensive comments, the United States Environmental Protection Agency wrote that *"the PEIS should describe the process and outcome for government-to-government consultation between the BLM, the USFS, and each of the tribal governments within the project area, issues that were raised (if any), and how those issues were addressed in the selection of the proposed alternatives."*

The agency also recommended *"...that BLM and USFS initiate consultation with the potentially affected tribes specific to their interests and concerns about cultural resources. The scope of impacts on cultural resources should include the direct, indirect, and cumulative impacts on*

- *sacred sites;*
- *traditional cultural properties or landscapes;*
- *hunting, fishing, gathering areas (including impacts on the ecosystems that support animals and plants and that are, or once were, part of the Tribes and tribal descendants traditional resource areas;*
- *access to traditional and current hunting, fishing and gathering areas and species;*
- *changes in hydrology or ecological conditions of springs, seeps, wetlands, and streams, that could be considered sacred or have traditional resource use associations;*

- *travel routes that were historically used and travel routes that may be currently used; and*
- *historic properties, districts or landscapes."*

The agency recommends that *"the PEIS should address the existence of Indian sacred sites in the project area. It should address Executive Order 13007, distinguish it from Section 106 of the NHPA, discuss how BLM and the USFS will avoid adversely affecting the physical integrity of sacred sites if they exist, and address other requirements of the Executive Order."*

The agency recommends that *"that if adverse effects to traditional cultural properties, sacred sites, or other areas of cultural resource concern are identified, any Memorandum of Agreement (MOA) developed to resolve these concerns ...should be fully executed before the ROD is issued, and the ROD should provide for implementation of the MOA's terms."*

4.15.2 How Were the Potential Effects of Geothermal Development on Tribal Interests and Traditional Cultural Resources Evaluated?

Methods

As described in Section 3.15, tribal interests and traditional cultural resources are identified primarily through consultations with federally recognized Indian tribes on a government-to-government basis. Direct consultations are also needed to identify traditional cultural resources in the case of non-federally recognized tribes and other potentially affected communities. In some cases, ethnohistorical research or focused ethnographic studies are used to gather information and oral traditions related to particular locations and resource uses. These studies usually focus on researching the historical uses of the area, defining the important traditional places, natural resources and landscape features, identifying named places and documenting contemporary tribal uses of the project area. Field visits can be arranged for elders or persons with traditional knowledge who may associate a place or site with a tradition, practice, oral history, ancestral use, or belief important to the community's cultural life. Contemporary ties may be rediscovered to ancestral archaeological sites recorded as part of the planning process..

Tribal governments, along with the BIA and the Interior Office of the Special Trustee for American Indians, are sources for identifying Indian trust and treaty rights. Initial contacts have been made by the BLM and FS, and some responses have been received. Generally, specific tribal interests, and especially traditional cultural resources and sacred sites, cannot be identified on a programmatic basis, as analysis of specific impacts on these resources cannot be conducted at this scale. Coordination through BLM and FS tribal liaisons and other established programs would continue. Tribes and other parties would be engaged to identify interests and traditional cultural resources in the individual lease areas that may be impacted by geothermal development.

While not fully defined, tribal interests, trust resources, reserved treaty rights, and traditional cultural resources are present in the planning area. The potential effects of geothermal development were evaluated by consulting existing planning and guidance documents, ethnographic literature, local knowledge, and input from BLM, FS, and contractor staff and cultural resource specialists. Potential effects on common tribal interests and resource types are described to allow comparison of the programmatic alternatives, with the knowledge that site-specific consultation would be necessary to provide a full accounting of affected interests and resources and to define the context and intensity of impacts.

Impact Criteria

Potential impacts on tribal interests or traditional cultural resources could occur if anticipated future actions consistent with implementing the alternatives described in Chapter 2 were to:

- Conflict with land uses, management, and economic well being of adjacent or nearby reservations, trust lands, restricted Indian allotments, and federally tribal-dependent Indian communities;
- Conflict with the exercise of off-reservation treaty and reserved rights, including grazing rights, hunting and fishing rights, gathering rights and interests, and water rights;
- Conflict with the exercise of Alaska Native Subsistence Rights;
- Conflict with federal trust responsibilities to tribes and individual Indians regarding real property, physical assets, or intangible property rights;
- Conflict with existing court decisions, laws, policies, executive orders, and agency agreements with tribes regarding land and resource use;
- Result in proposed uses that are incompatible with maintaining and identifying cultural resources and their qualities;
- Have an adverse effect on historic properties or their settings, especially traditional cultural properties and cultural landscapes under Section 106 of the NHPA (36 CFR 800);
- Impact or restrict access to traditionally used hunting, fishing, and gathering areas and species;
- Change or reduce access to traditionally used or culturally important water sources and hot springs;
- Impact culturally important trails or trail systems; or

- Impact sacred sites or their settings, access, or use.

Assumptions

In accordance with 43 CFR 2301.11, the BLM is prohibited from issuing leases on Indian trust or restricted lands within or outside the boundaries of Indian reservations. These are lands in which the title is held by the United States in trust for an Indian or an Indian tribe or lands in which the title is held by Indians or an Indian tribe but is subject to restriction by the United States against transferring such property.

The authorized surface administrative unit of the BLM or FS would coordinate with Indian Tribal governments to identify issues regarding the lease and potential for geothermal energy development, including issues related to the presence of cultural properties, access rights, disruption to traditional cultural practices, and impacts on visual resources important to the tribe(s).

The authorized surface administrative unit of the BLM or FS would coordinate with tribes and State Historic Preservation Officers regarding historic and cultural resources per Section 106 of the NHPA. The presence of archaeological sites and historic properties in the lease area shall be determined on the basis of a records search of recorded sites and properties in the area and, depending on the extent and reliability of existing information, an archaeological survey. Archaeological sites and historic properties present in the leasing area shall be reviewed to determine whether they meet the criteria of eligibility for listing on the NRHP. Additional specific consultation requirements would be determined on a project-by-project level and during the ADP process.

The PEIS includes standard NSO/NGD stipulations to protect cultural resources. An authorizing officer could grant exemptions to these stipulations on a case-by-case basis after determining that NSO/NGD is not warranted to achieve resource protection. Additional NSO/NGD stipulations could be applied by the authorizing officer to address specific location resource concerns. The following areas would have NSO/NGD stipulations:

- Within the setting of National Register-eligible sites, including traditional cultural properties, where setting is critical to their eligibility; and
- Areas with important cultural and archaeological resources, including Native American sacred sites.

4.15.3 What are the Common Impacts on Tribal Interests and Traditional Cultural Resources Associated with Geothermal Development?

Due to the inability to predict future development scenarios, including types of development, timing, and location, the following impact analysis provides a general description of common impacts on tribal interests and traditional cultural resources from geothermal resource development.

Areas proposed for leasing would likely include lands where there are tribal interests and traditional cultural resources that are not currently identified. The BLM or the FS would coordinate with Indian Tribal governments to identify issues and concerns regarding the lease and potential for geothermal energy development. Agency staff also may be aware of locally sensitive areas and resources from previous consultation and identification efforts of tribal trust and treaty concerns. However, affected groups may not wish to enter into direct consultation or may prefer not to discuss specific traditional use areas or sacred sites until development plans are proposed and there is a perception that interests or resources would be threatened.

Issuing geothermal leases confers on the lessee a right to future exploration and development of geothermal resources within the lease area. Thus, it is a conditional commitment or granting of a right that may interfere with other uses or interests such as land-into-trust applications by tribes, or acquisition (restoration) of a tribe's ancestral land base or resources. There may also be unidentified conflicts with existing tribal treaty rights or claims of ownership related to hot springs and water sources.

Leasing does not confer on the lessee the right to conduct any ground-disturbing activities to explore for or develop geothermal resources without further review and permitting. Impacts may be minimized or avoided through any required consultations, environmental review, and NSO/NGD stipulations. Types of impacts that could occur from exploration, drilling operations, utilization, and reclamation and abandonment include direct disturbance of locations or landscapes associated with traditional beliefs, resource gathering areas, hunting and fishing areas, water sources, hot springs, ancestral sites, human remains, and trails. Other impacts could result from alterations of visual, aural, or other aspects of setting both on the lease site and in adjacent areas; increased access and vandalism; decreased access or interference with the exercise of treaty rights or cultural uses; and the potential for erosion, pollution, habitat loss, and less tangible changes to natural features and resources that tribal members may consider sacred.

Consultation and review at the different stages of exploration and development would avoid or address many potential impacts; however, there may be residual effects on traditional cultural resources that may be difficult or impossible to adequately mitigate.

The Reasonable Foreseeable Development Scenario for Tribal Interests and Traditional Cultural Resources

According to the RFD scenario, it is estimated that 111 power plants could be constructed by 2015, and another 133 power plants could be constructed by

2025. The most development is expected to occur in California and Nevada, with the least occurring in Colorado, Arizona, Wyoming, and Montana. A representative amount of disturbance of the geothermal resource development phase is 53 to 367 acres. Land directly disturbed would be approximately 5,883 acres to 40,737 acres by 2015 and 12,932 acres to 89,548 acres by 2025. This is only a small percentage of the land managed by the BLM and FS in the western US.

Surface exposures of geothermal resources such as hot springs are commonly very important to tribes and are often connected with ritual use and spiritual meaning. Exploration, drilling operations, and utilization from these sources would likely impact traditional cultural resources and could possibly impact other tribal interests. Impacts could include loss of access, interference with use, and changes in flow or temperature of hot springs. Since the thermal water in these springs is often considered sacred, there is a potential for loss of sacred sites, and the healing energy and power they provide to the tribal users who value them.

Also relevant are impacts on the setting and cultural landscapes of tribal interests and traditional cultural properties, which can extend far beyond the land that is directly disturbed. Consultation, review, and permitting are required for the exploration, drilling operations, and utilization phases.

Exploration

The exploration phase includes surveying and drilling temperature gradient wells. Surveying can include a variety of field studies and sampling. Surveying and drilling temperature gradient wells would likely require some minor surface disturbance for site access, site investigations, and placement of several small well sites. Grading typically would not be required at well sites, but land would be disturbed by equipment use. Drilling wells would require temporary equipment placement and would generate noise.

Potential impacts could result if tribal interests or traditional cultural resources are located on lands disturbed by road, sampling, and well locations. Access roads, investigations, and establishing well sites can also lead to impacts from vandalism, unauthorized collection of ancestral sites, alteration of cultural landscapes, noise, and interference with traditional religious or cultural practices such as resource gathering or hunting. The context and intensity of the impact would depend on the resources that may be present and identified, and whether the resources can be avoided. Impacts may be minimized or avoided through any required consultations, environmental review, and NSO/NGD stipulations. Compared to the other phases of geothermal development, exploration involves the least potential for permanent, long-term impacts.

Drilling Operations
Potential impacts are similar to the exploration phase, with additional construction to accommodate injection wells and sump pits.

Utilization
The utilization phase, combined with drilling operations above, would directly disturb 51 to 350 acres to accommodate construction, well pads, power plants, additional roads, pipelines for direct use applications, and electrical transmission lines. Landscapes would be changed by the addition of large structures, security lighting, transmission lines, and steam plumes and by the loss of natural cover, landforms, and habitats. Construction would require heavy equipment use and many workers on-site and would result in noise, vehicular traffic, and fugitive dust.

Potential impacts could result if tribal interests or traditional cultural resources are located on land disturbed or converted to other uses by the construction. Exercise of tribal treaty rights and use of traditional cultural resources, resource gathering areas, and sacred sites on adjacent lands may not be possible due to intrusions to setting, loss of habitat, and security fencing. Areas considered sacred and the qualities that make them important to traditional practitioners may be permanently lost. Creating access roads and introducing large numbers of workers on-site may impact resources through vandalism, unauthorized collection, and damage of ancestral sites. Impacts on setting, important view sheds, and cultural landscapes may extend far beyond the project area. The context and intensity of the impact would depend on the resources that may be present and identified and whether the resources can be avoided. Impacts may be minimized or avoided through any required consultations, environmental review, and NSO/NGD stipulations. The utilization phase involves the most potential for permanent, long-term impacts.

Short-term minor impacts would occur from standard operation and maintenance activities, such as maneuvering construction and maintenance equipment and vehicles associated with these activities. Additional impacts could occur during this phase if production is expanded or if an additional drill site is required. Consultation and monitoring may be required to ensure that commitments regarding exclusion zones and access for traditional users are maintained.

Reclamation and Abandonment
Reclamation and abandonment activities include abandoning the well after production ceases and reclaiming all disturbed areas. All disturbed lands would be reclaimed in accordance with BLM and FS standards. In some areas, land may be reused for other purposes rather than restored.

While visual and aural settings could be restored and it may be possible to restore some habitats, it is unlikely that some cultural or sacred uses could be restored. Changes in flow or temperature of hot springs would not be restored, and cultural uses and religious value may be permanently lost.

4.15.4 What are the Potential Impacts on Tribal Interests and Traditional Cultural Resources Associated with the Proposed Action and Alternatives?

The following discussion analyzes the general environmental consequences expected to occur as a result of implementing the alternatives described in Chapter 2. Impacts are discussed generically, because the presence, absence, or location of tribal interests and traditional cultural resources and their relation to potential geothermal development are not known.

Impacts under Alternative A

Under the no action alternative, geothermal leasing for direct and indirect use would continue to occur on a case-by-case basis. Geothermal leases for direct and indirect use would be issued based on existing land use plans and future amendments and revisions. Many current land use plans do not specifically address geothermal leasing and its effects on tribal interests and traditional cultural resources.

Under this alternative, areas closed to geothermal leasing by statute, regulation, or orders would remain closed, and discretionary closed areas would be assessed based on local land use plans. Standardized protections through closures, lease stipulations, best management practices, or procedures for tribal interests and traditional cultural resources would not be implemented for public and NFS lands in the western states. Similar protections for other resource values that can also preserve tribal interests and traditional cultural resources would not be implemented. Because uniform standards would not apply, there may be inconsistent identification and consideration of impacts on tribal interests and traditional cultural resources.

The BLM would still be prohibited from issuing leases for direct and indirect use on Indian trust or restricted lands within or outside of the boundaries of Indian reservations. Compliance with NEPA, NHPA, and Executive Orders 13007 and 13084 would still be required, reducing the potential for impacts. Issuing geothermal leases for direct and indirect use on a case-by-base basis or through land use plan provisions could result in higher or lower levels of protection and consideration of tribal interests and traditional cultural resources than through the PEIS. The types of impacts that could occur would be similar to those described in Section 4.15.3, above, for each phase of the RFD scenario. The number of acres likely to be affected under this alternative is unknown.

Impacts under Alternative B

Under Alternative B, the proposed action, geothermal leasing for direct and indirect use would be open on approximately 118,000,000 acres of public land and 79,000,000 acres of National Forest System land in the 12 western states. Lands identified as open for geothermal leasing for direct and indirect use could be open with moderate to major constraints, depending on environmental conditions identified during site-specific reviews conducted by field offices and ranger districts prior to issuing leases. Approximately 48,520,000 acres would be closed to geothermal leasing for direct and indirect use because these lands were found to be incompatible with geothermal leasing, exploration, and development. Existing land use plans would be amended to reflect the leasing standards of this PEIS, but individual field offices and ranger districts could modify these standards in keeping with pre-existing agreements on resource protections. Higher or lower levels of protection and consideration of tribal interests and traditional cultural resources could result in areas where development is currently governed through land use plan provisions or agreements.

Under Alternative B, the potential for impacts on tribal interests and traditional cultural resources would be the same as described for each phase of the RFD scenario described in Section 4.15.3. Impacts on tribal interests and resources on most public and NFS lands would be minimized or avoided through consistent guidance for future geothermal leasing, including closures, any required consultations, environmental reviews, and stipulations. Indian trust or restricted lands within or outside the boundaries of Indian reservations would remain closed to leasing for direct and indirect use. For all lands open to geothermal leasing, compliance with NEPA, NHPA, and Executive Orders 13007 and 13084 would be required reducing the potential for impacts. No surface occupancy would be allowed in areas with important cultural and archaeological resources, such as traditional cultural properties and Native American sacred sites, as identified through any required government-to-government consultation with tribes (Section 2.2.2). It is expected that these measures, along with the measures outlined under cultural resources, will minimize impacts on tribal interests and traditional cultural resources, however there may be residual effects that are difficult or impossible to adequately mitigate.

Impacts under Alternative C

Under Alternative C, approximately 61 million acres of public lands and 38 million acres of NFS lands would be identified as open for indirect use leasing within 10 miles of existing transmission lines and at least 15 miles outside of the Yellowstone National Park boundary.

Potential impacts on tribal interests and traditional cultural resources would be similar in type to those described in Section 4.15.3 for each phase of the RFD scenario. Indirect use geothermal leasing would be concentrated and encouraged primarily within transmission line buffers, reducing the need to disturb additional lands and visual settings and reducing potential impacts in other areas. By locating leases and future development in places that may already have some level of disturbance, it is less likely that certain kinds of tribal interests and traditional cultural resources would be present or impacted.

Areas open to direct use geothermal lease applications and impacts from their subsequent development would be the same as identified under Alternative B.

4.16 NATIONAL SCENIC AND HISTORIC TRAILS

4.16.1 What did the Public Say about Impacts on National Scenic and Historic Trails?

Although several comments pertained to cultural resources in general, only three specifically addressed National Scenic and Historic Trails. The California Wilderness Coalition, The Wilderness Society, and The Wilderness Society and Western Resource Advocates all requested that no permitting be allowed in or adjacent to designated National Scenic and Historic Trails.

4.16.2 How Were the Potential Effects of Geothermal Development on National Scenic and Historic Trails Evaluated?

Potential impacts on National Scenic and Historic Trails could occur if reasonably foreseeable future actions were to:

- Conflict with management goals and objectives set forth by the agency or agencies responsible for trail-wide management and by the BLM or FS with on-site jurisdiction in order to sustain these resources and their visual or historic qualities;
- Result in proposed uses that are incompatible with maintaining and identifying National Scenic and Historic Trails and their qualities within and adjacent to their boundaries;
- Utilize all or any portion of a National Scenic and Historic Trail during any phase of geothermal development; or
- Install facilities or transmission lines within a National Scenic and Historic Trail's historic or scenic landscape.

Assumptions

The analysis assumes that land occupied by National Scenic and Historic Trails would be closed to leasing and that controlled surface use stipulations (CSUs) to leases would be used to apply BLM VRM Class II management objectives, unless otherwise designated. Some trail segments are currently protected by larger surface occupancy or visual buffers, and the BLM field office or FS ranger district with on-site jurisdiction would have the discretion to retain more restrictive buffers. Some trail segments are collocated with modern highways or other disturbances, and BLM VRM Class II management objectives may not be appropriate.

4.16.3 What are the Common Impacts Associated with Geothermal Development?

Due to the inability to predict future development scenarios, including types of development, timing, and location, the following impact analysis provides a general description of common impacts on National Scenic and Historic Trails from geothermal resource development.

The Reasonable Foreseeable Development Scenario for National Scenic and Historic Trails

According to the RFD scenario, it is estimated that 111 power plants could be constructed by 2015, and another 133 power plants could be constructed by 2025. The typical acreage of disturbance in a complete geothermal resource development is 53 to 367 acres. Therefore, total land use disturbance would be approximately 5,883 acres to 40,737 acres by 2015 and 12,932 acres to 89,548 acres by 2025. The four phases of geothermal development involve different levels of geothermal activity. The varying levels of geothermal activity influence the level of impact on National Scenic and Historic Trails. Impacts for each phase for a typical plant are discussed below.

Exploration

The exploration phase includes surveying and drilling temperature gradient wells.

Surveying activities would impact historical and scenic trails if additional roads or routes are developed across or within the trail's historic or scenic landscape. Additional roads could lead to increased disturbances along trails and within their landscapes. The magnitude and extent of the impact would depend on the current modern uses in the area. Any permanent construction or disturbances would be long-term impacts.

The magnitude and extent of impacts on National Scenic and Historic Trails from drilling temperature gradient wells would again depend on the current modern uses in the area. Similar to surveying activities, roads would be required to access wells, and impacts would be similar. Several wells could be drilled per lease, and drilling activity could disturb approximately 0.9 acres. Ground disturbances would occur on lands directly under the well sites, which does not typically involve leveling or grading; these impacts would last only the duration of the drilling and reclamation activities (several weeks). If wells and appurtenances are constructed within the route of a National Scenic and Historic Trail or within a trail's historic or scenic landscape, impacts would be considered short term if structures are temporary and long term if structures are permanent.

Drilling Operations

Geothermal drilling operations would result in impacts on National Scenic and Historic Trails if allowed within the boundaries of a trail or its landscape. The drilling operations phase would require access roads to accommodate larger equipment. New roads would have similar impacts to those identified during the exploration phase.

The drilling operations phase also includes drill site development, which on average requires a two-acre well pad to accommodate additional production wells, injection wells, and sump pits. Land under the well pad may include a portion of a National Scenic or Historic Trail route and would be impacted by ground disturbance.

Utilization

Construction of a geothermal power plant and its associated infrastructure (e.g., well field equipment) during the onset of the utilization phase would create impacts if a portion of a National Scenic or Historic Trail route would be impacted by ground disturbance. These impacts would be limited to the construction period.

The well field equipment consists of pipelines that vary from 24 to 36 inches in diameter. Where feasible, pipelines would parallel access roads and existing roads, some of which may be National Scenic and Historic Trails. A power plant requires approximately 15 to 25 acres to accommodate all the needed equipment and would represent a large modern development on a historic or scenic landscape. Installing electrical transmission lines from the power plant would disturb approximately one acre per mile of transmission line. Lines may cross trails and their landscapes. Long-term impacts on National Scenic and Historic Trails would result from construction of these modern developments within the route or historic or scenic landscape of the affected trail.

Reclamation and Abandonment

Reclamation and abandonment activities include abandoning the well after production ceases and reclaiming all disturbed areas. All disturbed lands would be reclaimed in accordance with BLM and FS standards. Unless the development and changes from the exploration, drilling operations, and utilization phases are removed and the preexisting conditions are reestablished, all impacts on National Scenic and Historic Trails from those previous phases would continue.

4.16.4 What are the Potential Impacts Associated with the Proposed Action and Alternatives?

The following discussion analyzes the environmental consequences or impacts expected to occur as a result of anticipated future actions consistent with implementing the alternatives described in Chapter 2. In the absence of site-specific data, including site location, only a general analysis of impacts on National Scenic and Historic Trails is possible at this time.

Impacts under Alternative A

Under the no action alternative, lease applications would continue to be processed on a case-by-case basis. Areas closed to geothermal leasing by statute, regulation, or orders would remain closed, and discretionary closed areas would be assessed based on local land use plans. The number of acres likely to be affected under this alternative is unknown.

Issuing geothermal leases for direct and indirect use on a case-by-base basis is not expected to affect National Scenic and Historic Trails. The case-specific studies required prior to issuance of a lease would be expected to prevent many impacts on National Scenic and Historic Trails. Development would require construction of facilities and transmission lines, which could alter the historic or scenic landscape of the affected trails. Under this alternative, no comprehensive list of stipulations, best management practices, or procedures would be distributed to serve as a consistent guidance for future geothermal leasing and development. This would result in fragmented and segregated planning for preventing impacts on National Scenic and Historic Trails, which often exponentially increases recognized environmental impacts. Due to the uncertainty of total acreage considered for geothermal leasing and development under this alternative, it is not possible to quantify the total acreage affected on federal lands.

Impacts under Alternative B

Under Alternative B, the proposed action, geothermal leasing for direct and indirect use would not be allowed on National Scenic or Historic Trails, and BLM VRM Class II management objectives would be applied. This would prevent or reduce impacts from occurring within the route of a designated trail and its historic or scenic landscape. Development would require construction of facilities and transmission lines, which could alter the historic or scenic landscape of the affected trails. Approximately 6,173 miles of National Scenic and Historic Trails traverse the planning area and would be afforded additional protections under Alternative B. However, if a trail's associated historic or scenic landscape extends farther than one mile from the route, the trail could be impacted by the various phases of geothermal development.

Under this alternative, the BLM and FS would issue a comprehensive list of stipulations, best management practices, and procedures to serve as consistent guidance for future geothermal leasing for direct and indirect use. Relevant stipulations (Section 2.2.2) designed to minimize impacts on National Scenic and Historic Trails include (1) no surface occupancy within the setting and boundary of properties designated or eligible for the National Register of Historic Places, including National Landmarks and National Register Districts and Sites; and additional lands outside the designated boundaries to the extent necessary to protect values where the setting and integrity is critical to their designation or eligibility; and (2) controlled surface use in sensitive viewsheds within the visual setting of National Scenic and Historic Trails to maintain VRM Class II objectives, unless otherwise designated.. In addition, in accordance with BMPs (Appendix D), BLM and operators would contact appropriate agencies, property owners, and other stakeholders early in the planning process to identify potentially sensitive recreational areas and issues such as trails. It is expected that these measures would effectively avoid or minimize impacts on National Scenic and Historic Trails by protecting the most significant trails, maintaining recreational opportunities and recreational experience, and reducing user and resource conflicts.

Impacts under Alternative C

Under Alternative C, geothermal leasing for direct and indirect use would not be allowed on National Scenic or Historic Trails, and BLM VRM Class II management objectives would be applied to scenic and historic landscapes. This would result in impacts similar to those under Alternative B, but with fewer landscapes afforded the additional standard protections around designated trails during leasing and development for indirect use. Leasing and development would presumably be more likely to occur in areas that may be already altered by transmission lines, and new disturbances to scenic or historic landscapes may be avoided.

4.17 VISUAL RESOURCES

This section analyzes impacts on visual resources as a result of activities described in the RFD scenario, which involves the four sequential phases of geothermal development: 1) exploration, 2) drilling operations, 3) utilization, and 4) reclamation and abandonment.

4.17.1 What did the Public Say about Impacts on Visual Resources?

Scoping was conducted to determine issues of concern with respect to the proposed project. The following issues of concern relating to visual resources were identified during scoping:

- Effects on scenic resources from road and other transmission corridor developments;
- Effects on open space from development;
- Effects on scenic values associated with cultural resources and recreation from geothermal development; and
- General and specific BMPs to preserve scenic quality.

4.17.2 How Were the Potential Effects of Geothermal Development on Visual Resources Evaluated?

Potential impacts on visual resources are based on interdisciplinary team knowledge of public lands and National Forest System lands, review of literature, and information gathered from the public during the planning process. To the extent practical, spatial data were used to compare environmental conditions with the alternatives. Various actions that might create changes to the basic landscape elements (such as form, line, color, and texture) were considered in identifying potential impacts. Effects are quantified where possible. In the absence of quantitative data, best professional judgment was used to describe impacts using qualitative terms. Impacts were assessed according to the following assumptions:

- Scenic resources would remain in demand on public lands and NFS lands;
- The demand for recreational use would continue to increase, thereby increasing the value of open spaces and undeveloped landscapes containing scenic resources;
- Any new surface-disturbing geothermal activities would be subject to further NEPA analysis, which would include an analysis to determine consistency with applicable visual resource objectives. NEPA analysis within VRM Management Class I, II, and III would include contrast rating evaluations and photo simulations in accordance with BLM Handbook H-8431-1, Visual Resource Contrast Rating; and

- Proposed activities that would not initially meet applicable visual resource objectives for an area would be mitigated to the extent needed to meet the objectives. Those proposed activities that could not be mitigated would not be authorized.

Impacts on visual resources can be either positive or negative, depending on the type and degree of visual contrasts introduced to a landscape. Where modifications repeat the general elements of the natural landscape, the degree of visual contrast is lower, and the impacts are generally perceived less negatively. Where modification introduces pronounced changes, the degree of contrast is greater, and impacts are often perceived more negatively.

The potential risk of impacts on visual resources is assessed for five significance criteria. Potential impacts on visual resources could occur if reasonably foreseeable future actions were to result in the following:

- Have adverse effects on a scenic vista;
- Damage a scenic resource within a scenic roadway;
- Degrade the existing visual character or quality of the site and its surroundings;
- Create a new source of light or glare; or
- Be incompatible with the VRM system, the SMS, or other applicable visual resource objectives.

Receptors sensitive to disturbances of visual resources are varied and depend on the landscape's visual resources; the project's location; the view distance, angle, and duration; the location of travel routes; public areas of interest; the season; the topography; recreation activities; and the number of viewers. Because of this, it is important to note that site-specific impact assessment is needed to thoroughly assess impacts on visual resources from a particular project. Without precise information about a specific project, it is not possible to detail the visual impacts. However, by using the RFD scenario as a general description of expected geothermal resource development activities, a generalized assessment of the possible impacts on visual resources can be made by describing the range of expected visual changes.

4.17.3 What are the Common Impacts on Visual Resources Associated with Geothermal Development?

Future actions based on the RFD scenario could result in impacts on visual resources. Due to the inability to predict precise future development scenarios, including types of development, timing, and location, the following impact analysis provides a general description of common impacts on visual resources from geothermal resource development. The exact level of impact would depend on the actual intensity of geothermal resource development activity.

The Reasonable Foreseeable Development Scenario for Visual Resources
The four sequential phases of geothermal development involve different levels of geothermal activity. The varying levels of geothermal activity influence the level of impact on visual resources.

Exploration
Exploration can involve field surveys and temperature gradient well activities. Field surveys are typically conducted on foot or by using four-wheel drive vehicles and involve collecting data pertaining to the local geothermal resource. Temperature gradient wells are typically drilled using a truck-mounted rig and support equipment. The temperature gradient wells range from 200 feet to over 4,000 feet deep. No permanent structures are constructed for field surveys or temperature gradient wells. As a result of field surveys and temperature gradient well activities, the following alterations to visual resources would occur during the exploration phase:

- Vegetation damage;
- Scarring of the terrain from vehicles;
- Truck-mounted drilling rig and support equipment detracting from the natural environment; and
- Lighting during drilling and for safety.

Minimal reclamation is needed to return visual resources to pre-disturbance conditions, because exploration activities are limited in duration and are relatively small in physical size and areal extent. The BLM and FS would develop and approve reclamation requirements. Compared to the other phases of geothermal development, exploration involves the least amount of permanent, long-term disturbance to the visual environment.

Stipulations involving NSO/NGD would be applied to public lands designated as VRM Class I and National Forest System lands designated as Very High in order to protect scenic resources. Activities that would not comply with NSO/NGD stipulations would not be allowed on those lands.

National Forest System lands designated as High involve landscapes where the valued landscape character appears intact. Deviations may be present but must repeat the form, line, color, texture, and pattern common to the landscape character so completely and at such scale that they are not evident. National Forest System lands designated as Moderate involve landscapes where the valued landscape character appears slightly altered. Noticeable deviations must remain visually subordinate to the landscape character being viewed.

The objective of VRM Class II public land is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low.

Management activities may be seen but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.

The impacts on visual resources from the exploration phase on these three types of lands would be evident and would create a landscape that does not appear intact, mostly from the use of a truck-mounted drilling rig. A drilling rig would be a noticeable deviation and would attract the attention of casual observers. It is assumed that BLM and FS best management practices, standard operating procedures, and requirements for geothermal explorations would be implemented for all land designations to reduce impacts on visual resources. Also, at the very least, mitigation measures would be necessary for National Forest System lands designated as High and Moderate and public lands designated as VRM Class II to further reduce impacts on visual resources. Mitigation may also be necessary for lands with visual resources of lesser quality once site-specific analysis is conducted.

Drilling Operations

Drilling operations can involve assembling infrastructure in order to use the geothermal resource. For indirect use, the infrastructure can include roads, sump pits, production-size wells, injection wells, well field equipment, and reclamation around wells. The production-size wells can be over two miles (10,560 feet) deep. As a result of assembling infrastructure, the following alterations to visual resources would occur during the drilling operations phase:

- Visibility of activities involving construction work;
- Vegetation damage;
- Altering the natural landform or contours;
- Clearing of vegetation for roads;
- Building new roads;
- Scarring of the terrain from construction work;
- Fugitive dust from construction activities and newly exposed soils; and
- Lighting during construction.

Furthermore, depending on the location, this phase of geothermal activity could also alter a scenic vista or scenic roadway, fragment the open space of the landscape, or reduce the aesthetics of recreation or cultural areas.

Reclamation would occur after development activities to return visual resources to pre-disturbance conditions. Areas where reclamation would occur include temporary roads, staging areas, and well head areas. The BLM and FS would develop and approve reclamation requirements.

Stipulations involving NSO/NGD would be applied on public lands designated as VRM Class I and National Forest System lands designated as Very High in order to protect scenic resources. Activities that would not comply with NSO/NGD stipulations would not be allowed on those lands.

The impacts on visual resources on National Forest System lands designated as High and Moderate and public lands designated as VRM Class II would be the same as those described above under exploration. National Forest System lands designated as Low involve landscapes where the valued landscape character appears moderately altered. Deviations begin to dominate the valued landscape character being viewed, but they borrow valued attributes such as size, shape, edge effect, and pattern of natural openings; vegetative-type changes; or architectural styles outside the landscape being viewed. They should not only appear as valued character outside the landscape being viewed but should be compatible or complimentary to the character within. The objective of VRM Class III public lands is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.

The impacts on visual resource from the drilling operations phase on these two types of lands would dominate the valued landscape and the view of the casual observer. It is assumed BLM and FS best management practices, standard operating procedures, and requirements for geothermal development would be implemented for all land designations to reduce impacts on visual resources. Also, mitigation measures would be necessary for National Forest System lands designated as Low and public lands classified as VRM Class III to further reduce impacts on visual resources. Mitigation may also be necessary for lands with visual resources of lesser quality once site-specific analysis is conducted.

Utilization

The utilization phase involves final construction of infrastructure in order to use the geothermal resource. Infrastructure can include roads, sump pits, production-size wells, injection wells, well field equipment, power plant facilities, and transmission lines. For indirect use, utilization also involves additional production well development and the operation and maintenance activities at the geothermal site. The utilization phase could last from 10 to 30 years. For direct use, utilization can involve similar activities; however, the utilization phase typically lasts for several decades, if not longer. The infrastructure needed for direct use of the geothermal reservoir also includes piping to convey the high-temperature water.

As a result, the following alterations to visual resources would occur during the utilization phase:

- Visibility of activities involving construction work;
- Vegetation damage;
- Alteration of the natural landform or contours;
- Clearing of vegetation for additional production wells;
- Building new structures and roads;
- Scarring of the terrain from construction work;
- Fugitive dust from construction activities and newly exposed soils;
- Release of steam plumes;
- Conversion of undeveloped land to land with human-made structures; and
- Lighting during construction.

Furthermore, depending on the location, this phase of geothermal activity could alter a scenic vista or scenic roadway, fragment the open space of the landscape, or reduce the aesthetics of recreation or cultural areas. These potential impacts would be an advancement of the impacts that occurred during the drilling operations phase.

Stipulations involving NSO/NGD would be applied to public lands designated as VRM Class I and National Forest System lands designated as Very High in order to protect scenic resources. Activities that would not comply with NSO/NGD stipulations would not be allowed on those lands.

The impacts on visual resources on National Forest System lands and public lands would be greater than those described above under the drilling operations phase.

Reclamation and Abandonment

For indirect and direct use, reclamation and abandonment involves abandoning the well after production ceases and reclaiming all disturbed areas in conformance with BLM and FS standards. As a result, the following alterations to visual resources would occur during the reclamation and abandonment phase:

- Visibility of activities involving demolition work and removal of surface structures and equipment;
- Regrading disturbed areas to pre-disturbance contours;
- Fugitive dust from demolition activities and newly exposed soils; and
- Removing weeds and replanting native vegetation.

Furthermore, depending on the location, this phase of geothermal activity could also enhance a scenic vista, a scenic roadway, the landscape's open space, or the aesthetics of recreation or cultural areas to pre-geothermal project conditions. It could also restore these types of visual resources to pre-geothermal development conditions, assuming no other project developments or activities were initiated in the surrounding area during the lifespan of the geothermal project that further degraded the visual resources associated with scenic vistas, roadways, open space, or recreation or cultural areas.

Stipulations involving NSO/NGD would be applied to public lands designated as VRM Class I and National Forest System lands designated as Very High in order to protect scenic resources. Activities that would not comply with NSO/NGD stipulations would not be allowed on those lands. The level of disturbance to visual resources on public lands and National Forest System lands with other visual resource objectives would be commensurate with the objectives for visual resources.

It is assumed BLM and FS best management practices, standard operating procedures, and requirements for geothermal reclamation and abandonment would be implemented for all land designations to protect visual resources during reclamation and abandonment activities. This phase is expected to result in a more long-term, natural appearance to the landscape.

4.17.4 What are the Potential Impacts on Visual Resources Associated with the Proposed Action and Alternatives?

The following discussion analyzes the environmental consequences or impacts expected to occur as a result of anticipated future actions consistent with implementing the alternatives described in Chapter 2.

Impacts under Alternative A

Under the no action alternative, lease applications would continue to be processed on a case-by-case basis. Areas closed to geothermal leasing by statute, regulation, or orders would remain closed, and discretionary closed areas would be assessed based on local land use plans. Older land use plans may fail to properly address potential geothermal resource development for direct or indirect use, thereby threatening visual resources from potential geothermal resource development activity that was not taken into consideration when the land use plan was originally prepared. Case-by-case evaluation could require additional NEPA documentation and possibly amendments to individual land use plans. The amendments to individual land use plans could be similar to or different from the alternatives analyzed in this PEIS, resulting in greater opportunities to degrade or protect visual resources, depending on local conditions.

Impacts under Alternative B

Under the proposed action, approximately 118 million acres of public land and 79 million acres of National Forest System lands would be open to geothermal leasing for direct or indirect use subject to existing laws, regulations, formal orders, and the terms and conditions of the standard lease form. The impacts under this alternative are the same as the impacts described above under Section 4.17.3.

Under this alternative, the BLM and FS would issue a comprehensive list of stipulations, best management practices, and procedures to serve as consistent guidance for future geothermal leasing for direct and indirect use. Relevant stipulations (Section 2.2.2) designed to protect the existing visual resources include (1) no surface occupancy for public lands designated as VRM Class I and NFS lands with a Scenery Management System integrity level of Very High; and (2) controlled surface use for sensitive viewsheds, including public lands with a VRM Class II, NFS lands with a Scenery Management System integrity level of High, or near National Historic Trails or residential areas. In addition, in accordance with the identified BMPs (Appendix D), BLM, FS, and operators would use site-design and other measures to achieve the appropriate VRM and Scenery Management System objectives. It is expected that these measures would effectively avoid or minimize impacts on visual resources by evaluating proposed surface disturbing activities for impacts on visual resources and incorporating appropriate visual resource design techniques to mitigate impacts.

Impacts under Alternative C

The impacts under this alternative are the same as the impacts described under Alternative B. However, the amount and degree of impacts on visual resources would be less under this alternative. Under Alternative C, the BLM and FS would only consider leasing lands for indirect use geothermal development within 10 miles from the centerline of existing transmission lines and at least 15 miles outside of the Yellowstone National Park boundary. All lands within this buffer would be designated as open and closed to leasing for indirect use using the criteria outlined in Chapter 2.

Approximately 61 million acres of public land and 38 million acres of National Forest System lands would be open to leasing for indirect use. Compared to Alternative B, there would be fewer impacts, because less land would be available for geothermal leasing for indirect use. Due to the proximity of the land to transmission lines, it is assumed that the land has moderate to low scenic value or has other human-made structures and detractions that have altered the natural landscape. As a result, the degree of change to visual resources would be less under Alternative C, because the land being considered for potential geothermal resource development is assumed to already be altered to some extent. This would not be the case for Alternative B, because land with potentially higher scenic value due to its distance from existing infrastructure (i.e., transmission lines) would be considered for potential geothermal resource development (for both direct and indirect use).

Areas open to direct use geothermal lease applications and impacts from their subsequent development would be the same as identified under Alternative B.

4.18 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

4.18.1 What did the Public Say about Impacts on Socioeconomics and Environmental Justice?

A number of comments relevant to socioeconomics and environmental justice were received.

The California Wilderness Coalition requested that the PEIS describe and discuss the costs associated with allowing and maintaining geothermal leases for each alternative.

The Idaho Conservation League and Utah Environmental Congress stated that the leasing plan needs to ensure that each geothermal power plant is cost effective and guarantee that the most kilowatts will be produced with the least amount of environmental impact. In addition, they requested that the PEIS examine direct and cumulative economic impacts for the RFD, including the economic costs of loss or degradation of public lands, wildlife habitats, quality of life, and infrastructure strains that accompany oil and gas development. They suggested that the BLM's Economic Profile System be used for this analysis.

Ormat, Inc. noted that the PEIS should recognize the numerous important long-term benefits of expanding geothermal energy, including creating new jobs, rural economic development, and income to state and local governments.

The Wilderness Society and Western Resource Advocates provided detailed recommendations for socioeconomic analysis. They suggested that the PEIS provide the following components in the analysis:

- Data and analysis that fully accounts for negative impacts from habitat fragmentation, loss of quality of life, and loss of quality recreation that geothermal development might have on tourism, recreation, hunting, and fishing; and
- An analysis of the income and jobs associated with recreation, hunting, and fishing for each alternative.

The organizations provided suggested references to guide the economic analysis of geothermal energy development.

In an extensive comment, the US Environmental Protection Agency directed the PEIS to evaluate minority and low-income populations in the project area and address the potential for disproportionate impacts on these populations. The letter also included detailed recommendations for facilitating public involvement with these populations. In addition, the EPA suggested that the procedure used for distributing royalties be outlined in the PEIS.

4.18.2 How Were the Potential Effects of Geothermal Development on Socioeconomics and Environmental Justice Evaluated?

Impacts were analyzed in terms of the predicted increase in megawatts of geothermal energy and the associated changes expected in employment, income, tax revenue, royalties, public infrastructure needs, and other socioeconomic factors. Quantitative estimates were provided, when available, based on the best available data. Where quantitative data were not available, professional judgment was used to describe impacts using qualitative terms.

In discussion of the RFD scenario, impacts are described for a standard 50-megawatt plant. Quantitative estimates are provided for selected economic indicators for the state and project area based on megawatt estimates.

When secondary impacts are discussed, an economic multiplier effect of 2.5 is applied, based on standard multiplier effects observed in the geothermal industry (US DOE 2006b). This means that one dollar of investment in a geothermal venture produces $2.50 in economic activity, or for every job created at a geothermal plant an additional 2.5 jobs are created. Only some of the secondary impacts would occur in the local community.

The degree of future geothermal development and the associated economic impacts are related to a number of uncertain economic factors. The existence of state- or federal-level renewable energy portfolios may increase the demand for renewable energy in the future. Section 1.8.3, Climate Change Policy, describes the current status of renewable energy standards. In addition, federal production tax credits may make renewable energy more cost competitive in the future. Current production tax credits provide a 1.9 cent tax credit for each kilowatt-hour of power produced by an eligible facility (or $19 per megawatt-hour), as adjusted annually for inflation. The current production tax credit is set to expire on December 31, 2008, but if extended it would likely increase the amount of geothermal development.

Potential impacts on socioeconomics and environmental justice could occur if reasonably foreseeable future actions were to result in the following:

- Impact other land uses that currently create revenue;
- Impact local industry that supports other land uses such as recreation and hunting;
- Impact the nonmarket values of open space;
- Affect expenditures or income within the study area associated with the project;
- Induce growth or population concentrations;
- Displace a proportion of available residences in a community;

- Create a demand for additional housing that could not be sustained within the project area;
- Cause a decrease in local or project area employment;
- Displace or disrupt businesses;
- Generate student enrollment that exceeds the school district's capability to accommodate students; or
- Have a disproportionately high and adverse impact on minority or low-income populations.

4.18.3 What are the Common Impacts on Socioeconomics and Environmental Justice Associated with Geothermal Development?

Due to the inability to predict future development scenarios, including types of development, timing, and location, the following impact analysis provides a general description of common impacts on socioeconomics and environmental justice from geothermal resource development.

The Reasonable Foreseeable Development Scenario for Socioeconomics and Environmental Justice

According to the RFD scenario, it is estimated that 111 power plants could be constructed by 2015, and another 133 power plants could be constructed by 2025. The greatest development is expected to occur in California and Nevada, with the least occurring in Arizona, Colorado, Wyoming, and Montana. Each power plant is predicted to have 50 megawatts of production capacity by 2025. Based on these estimates, direct economic impacts of geothermal plants and secondary impacts of new plant development are described below for the different phases of geothermal development. Table 4-8 provides a summary of the effects of RFD geothermal electricity generation broken down by state.

The largest impact on socioeconomics from power plants would result from employment and income directly associated with geothermal electricity plant construction and operation. Estimates for these impacts are discussed for each phase below. Currently, the government and government enterprise; retail trade; health care and social assistance; and accommodation and food services sectors provide the largest source of jobs for most states in the project area (Bureau of Economic Analysis 2007). Geothermal power plants may impact employment and incomes in these and other sectors. Impacts are discussed for each phase of development below.

Geothermal power plants can also generate substantial property taxes for the local county. Property taxes are based on the estimated value of the company assets. At the rate generated in Imperial County, California, as described in Chapter 3, an additional 367 million dollars in property tax may be produced in the project area annually under the RFD scenario. Land values for private tracts

Table 4-8
Direct Economic Impacts of Geothermal Electricity Generation under the Reasonably Foreseeable Development Scenario

	California	Nevada	Idaho	Oregon	Utah	Washington	New Mexico	Alaska	Arizona	Colorado	Montana	Wyoming	Total
Estimated Geothermal Electrical Generation by 2025 (MW)	4,730	2,880	1,670	1,250	620	600	170	150	50	50	n/a	**0**	**12,170**
Total Construction Jobs (temporary jobs)[1]	14,663	8,928	5,177	3,875	1,922	1,860	527	465	155	155	n/a	0	**37,727**
Construction Income (million $)[2]	851.4	518.4	300.6	225.0	111.6	108.0	30.6	27.0	9.0	9.0	n/a	0	**2,190.6**
Operations and Maintenance Jobs (permanent full-time jobs)[3]	3,500	2,131	1,236	925	459	444	126	111	37	37	n/a	0	**9,006**
Operations and Maintenance Income (million $)[4]	302.7	184.3	106.9	80.0	39.7	38.4	10.9	9.6	3.2	3.2	n/a	0	**778.9**
Property Tax Estimate (annual, in million $)[5]	143.3	87.3	50.6	37.9	18.8	18.2	5.2	4.5	1.5	1.5	n/a	0	**368.9**
Federal royalty estimate (30-year total, in million $)[6]	1,513.6	912.6	534.4	400	198.4	192	54.4	48	16	16	n/a	0	**3894.4**

[1] Assuming an average of 3.1 total construction jobs/MW, as discussed in Hance 2005.
[2] Assuming a rate of $9 million for 50-MW plant, as discussed in BLM 2007.
[3]Assuming a rate of .74 permanent full-time jobs per MW, as discussed in Hance 2005.
[4] Assuming a rate of $3.2 million annually for a 50-MW plant, as discussed in BLM 2007.
[5] At rate generated in Imperial County (NRC 2007).
[6] With average electricity price of 6 cents/kWh and 95 percent capacity factor, following Kagel 2006.

of land bordering geothermal development areas could also change, based on the development potential and possible profitability exhibited on adjacent geothermal lands. Potential increased land values could in turn provide additional revenue for counties. Secondary jobs and expenditures in the community are also likely to increase sales tax, providing extra income for the state and county government.

Royalties are another revenue stream for governments. Over 30 years, a 50-megawatt power plant would contribute an estimated $16 million to federal, state, and local governments in the form of royalties (Table 4-8). This calculation is based on Geothermal Steam Act royalty collection rates, as described in Chapter 3, and assumes an average electricity price of 6 cents per kilowatt-hour and 95 percent capacity factor. Without adjusting for inflation, every year for the first ten years a 50-megawatt geothermal plant would contribute $218,453 to the state, $109,226 to the federal government, and $109,226 to the county government. From the eleventh year on, without adjusting for inflation, every year the plant would contribute $436,905 to the state, $218,452 to the federal government, and $218,452 to the county (Kagel 2006). It should be noted that royalties are set as a percent of revenue and would therefore be dependant on future electricity prices, which are difficult to predict. An additional source of revenues come from bonus bids paid to acquire leases and lease rental fees. These fees vary by location, but can constitute an important source of revenue for states and counties during the period prior to production.

For direct use, it is estimated that applications could be developed in the amount of 1,600 thermal megawatts by 2015 and 4,200 thermal megawatts by 2025. Using low-temperature geothermal resources (between 70°F and 300°F) may generate revenue and creates jobs for some states. For example, four commercial geothermal greenhouses in rural, southern New Mexico employed up to 400 people. In 2002, these projects generated nearly $23 million in sales and paid more than $6 million in payroll. A one-million-square-foot greenhouse in rural Utah employs between 80 and 120 people throughout the year (National Geothermal Collaborative 2007).

Direct use of geothermal energy can offset the cost of heating and cooling associated with electricity. On average, geothermal heat pumps use 25 to 50 percent less electricity than conventional heating or cooling systems (US DOE 2006b). At four elementary schools in Lincoln, Nebraska where geothermal heat pumps have been installed, the heating and cooling savings total about $144,000 yearly, with total energy cost savings of 57 percent (NREL 1998).

The specific economic impacts of direct use are more difficult to predict than the impacts of power plants, as they are highly variable. Estimates are not available for direct-use phases of development.

Exploration

The exploration phase includes surveying and drilling temperature gradient wells. Activities such as gradient well drilling and seismic surveys could provide temporary jobs for the local community near geothermal resources. Expenditures for fuel, lodging, food, and other needs would provide a stimulus to the local economy.

Other land uses would generally not be impacted during the exploration phase; therefore, no long-term economic impact on these uses would occur. No long-term increases in population or growth would occur in this phase, and demand for schools would not increase.

The impacts on socioeconomic or environmental justice in this phase are expected to be low throughout the project area.

Drilling Operations

Drilling operations can involve assembling infrastructure in order to use the geothermal resource. For indirect use, the infrastructure can include roads, production-size wells, injection wells, well field equipment, and fluid sump pits.

Geothermal resource drilling operations would impact socioeconomics. The level of impact would vary depending on the size and location of geothermal development.

Air quality, water quality, noise, cultural resource, geological resource, and hazardous material impacts potentially resulting from geothermal development could impact minority or low-income populations on private lands adjacent to leasing areas. These potential environmental justice impacts would be mitigated through best management practices applied to specific project leases. Areas open to potential geothermal leasing may include lands of tribal concern, or having traditional cultural resources or sacred sites. Intergovernmental coordination with affected tribes prior to specific leases should limit negative impacts on Native American populations. Tribal consultation is further discussed in Section 4.15, Tribal Interests and Traditionally Cultural Resources.

Utilization

The utilization phase involves finalizing construction of infrastructure in order to use the geothermal resource. For indirect use, the infrastructure can include additional roads, sump pits, production-size wells, well field equipment, power plants, electric transmission lines, and reclamation around wells. For direct use, the infrastructure can include piping to convey the high-temperature water.

Construction employment for installing access roads, pipelines, transmission lines, drill sites, and power plants would likely occur, though the amount would vary depending on the resource potential. The type of employment and number of available jobs would also vary as the construction proceeds. Construction employment is expressed in person-month or person-year units. One person-month corresponds to the employment of one person during one month. Similarly, one person-year corresponds to the employment of one person during one year. Construction of a new geothermal plant averages 17 to 33 months and requires 37.4 person-months per megawatt, or 3.1 person-years per megawatt of power capacity installed (Hance 2005a). Based on these numbers, construction of a typical 50-megawatt power plant and the associated transmission lines would require 1,870 person-months, or 155 person-years. The personnel involved in well and transmission line construction would be temporary. Due to the variation in jobs available at different stages in construction, average employment would vary at any one time. Based on the estimates for construction worker income as described in the Truckhaven Geothermal Leasing EIS (BLM 2007l), income for construction jobs is estimated to be $9 million for a 50-megawatt plant (Table 4-8). Based on project area megawatt predictions, an estimated 37,727 total construction jobs and $2,190.6 million in construction income may be added by geothermal development under the RFD scenario.

Expenditures for equipment, materials, fuel, lodging, food, and other needs would stimulate the local economy over the duration of development. Applying a standard economic multiplier, development of a 50-megawatt power plant is estimated to create an additional 387 jobs and $22.5 million in income. The level of these impacts would vary depending on the community; therefore, this is a general estimate only. Some of the secondary impacts would occur in the local communities in which geothermal development occurs, while others would occur at a regional or national level.

The cost of geothermal plant development would vary depending on size and location of plants. A review of costs for current plants determined that average capital costs for new geothermal plant development is $1,969 per kilowatt or $98 million for a 50-megawatt plant (Hance 2005b).

Some economic impacts may occur should income and employment associated with ranching, recreation, hunting, mining, or other land use activities be altered by geothermal development. Constructing geothermal facilities will alter the landscape and nonmarket values of the immediate area, however the extent of impact would vary with each project. In the short term, other land uses and income derived from these uses may be displaced by geothermal development. In the long term, many other land uses may be compatible with geothermal use due to the small footprint of geothermal plants; however the aesthetic value would be permanently altered.

Habitat fragmentation created from constructing geothermal roads and pipelines in areas that contain wilderness characteristics could impact recreation, hunting, and wildlife viewing associated with these areas. Due to the fragmentation of the recreation and tourism industry, it is difficult to measure the effects to local businesses and economies. However, studies have shown that recreation and tourism development contributes to rural well-being, increasing local employment, wage levels, and income, reducing poverty, and improving education and health (USDA 2005). Public and forest service lands are both primary destinations and places of transition to other recreational destinations on Federal, State, or private lands, affecting economies both inside and outside of the project area. Recreation can be a significant source of income for some rural communities, especially communities adjacent to public lands or NFS lands. Congressionally closed areas discussed in Section 1.5, Leasing and Development Process of Geothermal Resources on Federal Lands would generally be closed to geothermal leasing; therefore, impacts on pristine wilderness environments would be minimal. As stated above, geothermal construction could impact values of areas that may contain wilderness characteristics adjacent to these wilderness areas. In general, while the recreational setting may change due to development in some areas, other recreational opportunities would become available due to increased accessibility. Therefore, the overall impact on recreation-related economics should be minimal. Please refer to Sections 4.2 Land Use, Recreation, and Special Designations and 4.13, Livestock Grazing for a detailed discussion of the impacts of geothermal development on these land use activities. The level of local economic impact of geothermal development activities on other land uses would vary depending on the location, timing, and size of geothermal development; therefore, specific impacts on jobs or incomes in these industries cannot be determined for the RFD scenario.

Another possible impact would be to broaden the economic base of the communities within the region of influence of geothermal resource area. This impact is particularly relevant in rural communities where employment sectors have typically been limited and unemployment rates are high.

Construction activities may require the in-migration of workers for certain occupational categories, which in turn could affect rental housing markets and schools and could create the need for additional state and local government expenditures and employment. Construction could also impact local businesses by pulling workers away from local positions to work on the temporary buildout. The population growth and need for additional infrastructure in a community would depend on a number of factors related to specific geothermal development sites, including skill level of local workers, unemployment rate in the local area, and existing state of rental market and public infrastructure.

For indirect use, operations could last from 10 to 30 years. For direct use, operations can involve similar activities; however, the utilization phase typically lasts for several decades, if not longer. During operations, jobs would continue to be available, but the high levels of construction jobs seen during the initial period of this phase would be reduced.

Based on employment numbers in a 2005 survey of the geothermal industry, an average of .74 person-years per megawatt annually is required for geothermal power plant operation and maintenance (Hance 2005a). Using this ratio, a 50-megawatt geothermal plant would require approximately 37 person-years annually or 37 permanent, full-time jobs. Using Truckhaven EIS estimates, payroll for these employees is estimated at $3.2 million annually (BLM 2007l) (Table 4-8). Based on RFD scenario megawatt predictions, 9,006 jobs and $778.9 million in payroll income is anticipated for operations and maintenance activities in 2025.

As during initial construction during the utilization phase, expenditures for equipment, materials, fuel, lodging, food, and other needs would stimulate the local economy over the duration of plant operation. Applying a standard economic multiplier, operations during the utilization phase of a 50-megawatt power plant are estimated to create an additional 93 jobs and $8 million in income. The exact level of these impacts would vary depending on the community; therefore, this is a general estimate only. Some of the secondary impacts would occur in the local communities in which geothermal development occurs, while others would occur at the regional or national level.

The operation of power plants may require the in-migration of workers for certain occupational categories. The population growth and need for additional infrastructure in a community would depend on specific projects and communities, but impacts would generally be less than those seen during the initial construction of the drilling operations phase, where a greater number of workers would be required.

Cost of geothermal plant operation would vary depending on the size and location of plants. The Western Governors Association estimated an average operation and maintenance cost of 22 cents per megawatt-hour (Western Governors' Association 2006b).

The potential impacts on economic streams for other land uses are the same as discussed in the drilling operations phase, above.

As with the drilling operations phase, the waste management and disposal associated with operation and additional well development could impact minority or low-income populations on lands adjacent to geothermal development areas. These potential environmental justice effects would be mitigated through best management practices.

Reclamation and Abandonment

Reclamation and abandonment activities include abandoning the well after production ceases and reclaiming all disturbed areas. All disturbed lands would be reclaimed in accordance with BLM and FS standards. The closeout phase would likely involve additional construction jobs for reclaiming disturbed areas. As in other phases, expenditures for equipment, materials, fuel, lodging, food, and other needs would stimulate the local economy. Best management practices would be used to minimize dust, noise, and other disturbance adjacent to communities so that potential environmental justice effects would be avoided. Reclamation could increase the aesthetic value and bring back income to local industry that supports use of that land for recreation and other uses.

4.18.4 What are the Potential Impacts on Socioeconomics and Environmental Justice Associated with the Proposed Action and Alternatives?

The following discussion analyzes the environmental consequences or impacts expected to occur as a result of anticipated future actions consistent with implementing the alternatives described in Chapter 2.

Impacts under Alternative A

Under the no action alternative, lease applications would continue to be processed on a case-by-case basis. Areas closed to geothermal leasing by statute, regulation, or orders would remain closed, and discretionary closed areas would be assessed based on local land use plans.

The specific economic impacts of this alternative cannot be determined. Employment, tax income, and other economic factors would likely continue to reflect the trends discussed in Chapter 3.

Under this alternative, no comprehensive list of stipulations, best management practices, or procedures would be distributed to serve as consistent guidance for future geothermal leasing and development for direct and indirect use. This would result in fragmented and segregated planning for socioeconomics and environmental justice, which often exponentially increases impacts.

Impacts under Alternative B

Under the proposed action, approximately 118 million acres of public land and 79 million acres of NFS lands would be identified as open to geothermal leasing for direct and indirect use subject to existing laws, regulations, formal orders, and the terms and conditions of the standard lease form. The impacts under this alternative are the same as the impacts described above in Section 4.18.3, What are the Common Impacts Associated with Geothermal Development.

Under Alternative B, a comprehensive list of stipulations, best management practices, and procedures would be provided to serve as consistent guidance for future direct and indirect use geothermal leasing. By designating specific areas as open or closed to geothermal leasing for direct and indirect use, implementing major and minor constraints and other measures focusing on best management practices, negative impacts on socioeconomics or environmental justice would be minimized.

Impacts under Alternative C

Under Alternative C, geothermal leasing for indirect use would be open on 61 million acres of public land and 38 million acres of NFS land. All federal lands identified as open for indirect use geothermal leasing under this alternative are located within 10 miles of the centerline of existing transmission lines and at least 15 miles outside of the Yellowstone National Park boundary.

The specific economic impacts of anticipated future actions consistent with this alternative on indirect use development cannot be determined. The general impacts are the same as discussed under Alternative B; however, the amount and degree of the impacts would be less under this alternative. Restricting the placement of indirect use geothermal resource development to existing transmission line areas would likely minimize impacts on socioeconomics and environmental justice by concentrating energy development into designated areas. Due to the proximity of the land to existing transmission lines, the land being considered for potential geothermal resource development under Alternative C is assumed to already be altered to some extent and to be closer to existing communities. Geothermal development on these lands is less likely to impact other land uses. Areas open to direct use geothermal lease applications and impacts from their subsequent development would be the same as identified under Alternative B.

4.19 HEALTH AND SAFETY

4.19.1 What did the Public Say about Impacts on Health and Safety?

Comments were related to the inclusion of appropriate BMPs and the consideration of using a Health Impact Assessment if concerns about potential health impacts from individual projects are identified.

4.19.2 How Were the Potential Effects of Geothermal Development on Health and Safety Evaluated?

Methodology

Potential effects of geothermal development on human health and safety were evaluated by examining the typical hazards associated with the various stages of geothermal development.

Impact Criteria

Potential impacts on health and safety could occur if reasonably foreseeable future actions were to:

- Create a hazard to the public through the routine transport, use, or disposal of hazardous materials;
- Create a hazard to the public through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment;
- Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within 0.25 mile of an existing or proposed school; or
- Be located on a site that is included on a list of hazardous materials sites compiled by the federal or state government and, as a result, would create a hazard to the public.

4.19.3 What are the Common Impacts on Health and Safety Associated with Geothermal Development?

Due to the inability to predict future development scenarios, including types of development, timing, and location, the following impact analysis provides a general description of common impacts on human health and safety from geothermal resource development.

Impacts on human health and safety from geothermal development projects could include:

- Exposure of individuals to drilling mud and geothermal fluid or steam during exploration and development drilling activities;

- Exposure of individuals to hydrogen sulfide contained in geothermal fluid or steam during exploration, development, and operation phases;
- Exposure of individuals to hazardous materials used and stored at facilities, such as petroleum, oil, lubricants, paints, solvents, and herbicides;
- Exposure of individuals to electrical fires or wildfires caused by project activities;
- Exposure of individuals to electric shock involved in maintenance of transmission lines and substations;
- Vehicular accidents due to increased traffic on local roads;
- A variety of potential accidents inherent in drilling operations, as listed in Section 3.19, Health and Safety; and
- A variety of potential accidents inherent to industrial facilities.

The Reasonable Foreseeable Development Scenario for Health and Safety

As stated in the RFD scenario, it is estimated that 111 power plants would be constructed across the 12-state project area by 2015, and a further 133 power plants could be constructed by 2025. The average capacity of these power plants is estimated to be 50 megawatts. For direct use, it is estimated that by 2015, applications could be developed in the amount of 1,600 thermal megawatts and by 2025, applications could be developed in the amount of 4,200 thermal megawatts. Each of these individual projects would introduce at least some of the aforementioned potential impacts on human health and safety.

Exploration

Potential health and safety impacts during the exploration phase would include those described above in Section 4.20.3 that are related to exposure of individuals to: 1) drilling mud during drilling activities; 2) hazardous materials used such as petroleum, oils, and lubricants; and 3) a variety of potential accidents inherent in drilling operations, as listed in Section 3.20, Health and Safety. Potential health and safety impacts would last for the duration of exploration activities, which is estimated to be between one and five years for an individual project.

Drilling Operations

Potential health and safety impacts during the drilling operations phase would include those described above in Section 4.20.3 that are related to exposure of individuals to: 1) drilling mud and geothermal fluid or steam during drilling activities; 2) hydrogen sulfide contained in geothermal fluid or steam; 3) hazardous materials used such as petroleum, oils, and lubricants; 4) wildfires caused by project activities; 5) vehicular accidents due to increased traffic on local roads; and 6) a variety of potential accidents inherent in drilling operations, as listed in Section 3.20, Health and Safety. Potential health and safety impacts during the drilling operations phase would range from two to ten years for an individual project. Additional potential impacts could arise from construction activities that were not present during exploration such as exposure to paints, solvents, herbicides, electrical fires, and other hazards typical of construction activities.

Utilization

Potential health and safety impacts during the utilization phase would include those described above in Section 4.20.3 that are related to exposure of individuals to: 1) geothermal fluid or steam during system failures, maintenance activities, or well blowouts; 2) hydrogen sulfide contained in geothermal steam emissions; 3) hazardous materials used such as petroleum, oils, lubricants, paints, solvents, and herbicides; 4) electrical fires and wildfires caused by project activities; 5) electric shock involved in maintenance of transmission lines and substations; and 6) vehicular accidents due to increased traffic on local roads. Potential health and safety impacts would last for the duration of operational activities, which is estimated to be between 10 and 30 years for an individual project.

Reclamation and Abandonment

Potential health and safety impacts during the reclamation and abandonment phase would include those described above in Section 4. 20.3 that are related to exposure of individuals to: 1) heat and hydrogen sulfide from geothermal fluid or steam during well capping; 2) hazardous materials used during dismantling of structures and reclamation of site such as petroleum, oils, and lubricants; 3) electrical fires or wildfires; 4) vehicular accidents; and 5) a variety of potential accidents inherent to demolition activities.

4.19.4 What are the Potential Impacts on Health and Safety Associated with the Proposed Action and Alternatives?

The following discussion analyzes the environmental consequences or impacts expected to occur as a result of anticipated future actions consistent with implementing the alternatives described in Chapter 2.

Impacts under Alternative A

Under the no action alternative, lease applications would continue to be processed on a case-by-case basis. Areas closed to geothermal leasing by statute, regulation, or orders would remain closed, and discretionary closed areas would be assessed based on local land use plans. Impacts would be site specific and similar to the impacts under the four phases of geothermal development identified under Section 4.20.3.

Impacts under Alternative B

There would be no impact on human health and safety from implementation of Alternative B; however, impacts resulting from anticipated future actions consistent with implementing Alternative B would be greater than such impacts under Alternative A. Alternative B would be expected to provide greater opportunities for large-scale and long-term improvements in air quality-related health indicators than Alternative A.

Under this alternative, the BLM and FS would issue a comprehensive list of stipulations, best management practices, and procedures to serve as consistent guidance for future geothermal leasing for direct and indirect use. In accordance with BMPs (Appendix D), operators would be required to implement actions that would protect public health and safety. For example, operators would be required to minimize air quality impacts, develop hazardous material management plans, develop waste management plans, establish safety zones, and develop fire management strategies. It is expected that these measures would effectively minimize impacts to health and safety from geothermal related actions.

Impacts under Alternative C

There would be no impact on human health and safety from implementation of Alternative C; however, impacts resulting from anticipated future actions consistent with implementing Alternative C would be greater than under Alternative A but less than under Alternative B, since fewer individual projects would likely be developed than under Alternative B. While Alternative C would allow greater opportunity than Alternative A for states within the project area to improve air quality regionally and therefore improve air quality-related health indicators, Alternative C would be inferior to Alternative B in this regard.

4.20 NOISE

4.20.1 What did the Public Say about Impacts on Noise?

No comments relating to noise were received during scoping.

4.20.2 How Were the Potential Effects of Geothermal Development on Noise Evaluated?

Methodology

Potential effects of geothermal development on noise were evaluated by examining the typical noise generation at the various stages of geothermal projects and the existing regulations and public health and safety guidance regarding noise exposure.

Regulations

Local city and county noise ordinances vary from site to site. As long as geothermal projects operate in compliance with the applicable regulations, they are not considered a noise nuisance in surrounding residential communities. All power facilities must meet local noise ordinances according to the phase of construction and operation.

Once geothermal operation sites are established, a further examination of state-specific laws and regulations would be required to ensure compliance with all noise pollution regulations.

Impact Criteria

Potential impacts on noise could occur if reasonably foreseeable future actions were to:

- Generate new sources of substantial noise;
- Increase the intensity or duration of noise levels to sensitive receptors; or
- Result in exposure of more people to high noise levels.

4.20.3 What are the Common Impacts on Noise Associated with Geothermal Development?

Due to the inability to predict future development scenarios, including types of development, timing, and location, the following impact analysis provides a general description of common impacts on air quality from geothermal resource development. Common noise impacts associated with each phase of development are described below.

The Reasonable Foreseeable Development Scenario for Noise

Noise pollution from geothermal power plants is typically considered during exploration, drilling operations, and utilization phases (Geothermal Energy

Association 2007a), with less emphasis on reclamation and abandonment. Direct use applications, due to the typically fewer wells and lack of electrical transformers, are considered to be less noise-generating, with most noise occurring during exploration and development.

Exploration

Noise generated during exploration is temporary in nature and is related to surveying and well drilling. Some temporary construction-related noise from access road and well-pad construction is also likely. The well drilling, stimulation, and testing phases of exploration produce noise levels ranging from about 80 to 115 decibels A-weighted at the site fence boundary. Exploration-related noise generation can last from one to five years (Massachusetts Institute of Technology 2006).

Drilling Operations

Noise generated during drilling operations would be similar to that under exploration, although longer durations of the noise related to the well drilling, simulation, and testing phase would be expected. In addition, construction of injection wells and sump pits would increase local noise in the short term.

Utilization

Construction of the direct use facility or power plant would generate noise for an estimated two to ten years.

Normal operations of a geothermal power plant typically generate noise levels in the 71 to 83 decibel range at a distance of one-half mile. Noise levels can be further reduced by the addition of mufflers or other soundproofing. Individual noise-generating components of operation include the transformer, the power house, and the cooling tower. Cooling towers are relatively tall and have noise-generating fans at the top, making them frequently the main source of noise during operation (Massachusetts Institute of Technology 2006).

Direct use applications do not have the noise-generating components of transformers, power houses, or cooling towers. Noise sources are generally limited to fluids moving through pipes and any pumping facilities associated with extraction and injection of geothermal fluids.

Reclamation and Abandonment

Noise associated with reclamation and abandonment activities would be limited to noises typical of any construction site, as facilities are dismantled and removed and the site is reclaimed.

4.20.4 What are the Potential Impacts on Noise Associated with the Proposed Action and Alternatives?

The following discussion analyzes the environmental consequences or impacts expected to occur as a result of anticipated future actions consistent with implementing the alternatives described in Chapter 2.

Impacts under Alternative A

Under the no action alternative, lease applications would continue to be processed on a case-by-case basis. Areas closed to geothermal leasing by statute, regulation, or orders would remain closed, and discretionary closed areas would be assessed based on local land use plans. Direct use and indirect use geothermal projects can be expected to continue to come online and generate noise at the existing pace of development.

Impacts under Alternative B

Impacts resulting from anticipated future actions consistent with implementing Alternative B would be greater than such impacts under Alternative A. Widespread geothermal leasing and development for direct and indirect use across the planning area would introduce many new noise sources; however, sensitive receptors such as schools, hospitals, and churches are typically not located on public lands, making it unlikely that such sensitive receptors would be exposed to noise resulting from geothermal development. Operations would have minimal noise impacts in most areas on federal lands; however, areas with minimal noise sources (i.e., remote areas) would experience a greater change in the noise characteristics. Projects would be required to meet state-specific regulations, reducing any impacts on off-lease area sensitive receptors or residential areas. Impacts on onsite workers would be minimal through the use of required hearing protection in noise-intensive operations.

Under this alternative, the BLM and FS would issue a comprehensive list of stipulations, best management practices, and procedures to serve as consistent guidance for future geothermal leasing for direct and indirect use. In accordance with BMPs (Appendix D), operators would be required to implement actions that would minimize impacts associated with noise. For example, operators would be required to take measurements to assess the existing background noise levels at a given site and compare them with anticipated noise levels. Operators would adequately muffle and maintain construction equipment and would notify nearby residents in advance of blasting or other noisy activities. It is expected that these measures would effectively minimize impacts on noise from geothermal related activities.

Impacts under Alternative C

Impacts resulting from anticipated future actions consistent with implementing Alternative C would be greater than such impacts under Alternative A, but less than such impacts under Alternative B since smaller land areas would be available for development and less development for indirect use would be likely to occur.

Areas open to direct use geothermal lease applications and impacts from their subsequent development would be the same as identified under Alternative B.

Chapter 5

Cumulative Impacts and Other Considerations

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CHAPTER 5
CUMULATIVE IMPACTS AND OTHER CONSIDERATIONS

5.1 INTRODUCTION

The analysis presented in this chapter, as required by Council on Environmental Quality regulations (40 CFR 1500-1508), addresses the potential cumulative impacts associated with Alternatives B (Proposed Action) and C (Leasing On Lands near Transmission Lines). Impacts associated with allocating public and NFS lands as open or closed to geothermal leasing and amending land use plans are placed into a broader context that takes into account the full range of impacts from reasonably foreseeable future actions in the 12-state project area. The Council on Environmental Quality regulations state that the cumulative impact analysis should include the anticipated impacts to the environment resulting from "the incremental impact of [an] action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over time" (40 CFR 1508.7).

Sections 5.2.2 through 5.2.5 describe the methodology, regions of interest, time frame, and reasonably foreseeable future actions for the cumulative impact assessment. Section 5.3 describes the types of actions and trends occurring on all (federal and nonfederal) lands in the project area. The cumulative impact analyses for each resource and resource use is presented in Section 5.4. Analysis on other type of impacts is provided in Section 5.5, unavoidable impacts; Section 5.6, short-term uses and long-term productivity; and Section 5.7, irreversible and irretrievable commitment of resources.

5.2 WHAT IS THE PROCESS OF ASSESSING CUMULATIVE IMPACTS?

The cumulative impact analysis in the following sections builds upon the analyses of the direct and indirect impacts of anticipated future actions to be taken consistent with Alternatives B and C. These analyses are presented in Chapter

4. In addition to those incremental impacts of anticipated future actions to be taken consistent with Alternatives B and C, the cumulative impact analysis considers other past, present, and reasonably foreseeable future actions' impacts on natural resources, ecosystems, and human communities in the 12-state project area.

5.2.1 What is the Methodology?

The cumulative effects analysis focuses on the natural resources, ecosystems, and human communities that could be affected by the impacts from Alternatives B and C (allocating public and NFS lands as open or closed to geothermal leasing and amending land use plans), in combination with other past, present, and reasonably foreseeable future actions, regardless of who undertakes them.

The Council on Environmental Quality discusses the assessment of cumulative effects in detail in its report, "Considering Cumulative Effects under the National Environmental Policy Act" (Council on Environmental Quality 1997). Because the allocation of lands as open or closed and the decision to lease do not have any direct impacts (see discussion at Section 4.1.1, Methods of Impact Analysis), the cumulative analysis focuses primarily on the cumulative impacts associated with the development of geothermal resources. That is, this analysis considers future actions anticipated to be taken consistent with the Proposed Action and the alternatives analyzed in this PEIS because it is more informative for the decision-making process. Based on the CEQ's report and this approach to informing the decision-making process, the following methodology was developed for assessing cumulative impacts:

1. The geographic scope (i.e., regions of influence) is defined for the analysis. The regions of influence encompass the areas of affected resources and the distances at which impacts associated with anticipated future actions to be taken consistent with Alternatives B and C may occur. The regions of influence are discussed in Section 5.2.3.
2. The time frame for the analysis is defined. The temporal aspect of the cumulative impacts analysis generally extends from the past history of impacts on each resource through the anticipated life of the project (and beyond, for resources having more long-term impacts). The time frame of the actions to be evaluated in the cumulative analysis is presented in Section 5.2.4.
3. Past, present, and reasonably foreseeable future actions are identified. These include projects, activities, or trends that could impact human and environmental resources within the defined regions of influence during the defined time frame. Past and present actions are generally accounted for in the analysis of direct and indirect impacts for each resource and are carried forward to the cumulative impacts analysis. Foreseeable future actions are described by type in Section 5.3.

4. The baseline conditions of resources are characterized. Baseline characteristics are described in the affected environment sections for each resource in Chapter 3.

5. Direct and indirect impacts on resources from anticipated future actions that may be taken consistent with the respective alternatives are characterized at a level appropriate for a programmatic analysis such as presented in this PEIS. Direct impacts are caused by anticipated future actions to be taken consistent with implementing an alternative, and they occur at the same time and place as those actions. Indirect impacts are caused by anticipated future actions to be taken consistent with the alternative but occur later in time or farther in distance from those actions and are still reasonably foreseeable. These impacts are detailed in the environmental consequences sections of Chapter 4 for each resource.

6. The potential impacting factors of each past, present, or reasonably foreseeable future action or activity are determined. Impacting factors are the mechanisms by which an action affects a given resource. Anticipated future actions to be taken consistent with both Alternatives B and C could also generate factors that could impact resources; these individual contributions form the basis of the cumulative impacts analysis.

7. The cumulative impact assessment focuses on past, current, and reasonably foreseeable future actions, including commercial uses, regardless of who undertakes them and regardless of where they are located in the 12-state project area. In other words, the assessment considers other uses on all lands in the 12-state project area regardless of land ownership. The descriptions of the other reasonably foreseeable future actions considered (Section 5.2.4) address all lands and, as such, the data include public and NFS lands. The data do not specifically break out public and NFS lands.

8. Cumulative impacts on resources are evaluated by considering the impacting factors for each resource and the incremental contribution of anticipated future actions to be taken consistent with implementing Alternatives B and C to the cumulative impact. The analysis for each resource is presented in Section 5.4.

In cases where the contributions of individual actions to an impacting factor were uncertain or not well known, a qualitative evaluation of cumulative impacts was necessary. A qualitative evaluation covers the locations of actions, the times they would occur, the degrees to which the impacted resource is at risk, and the potential for long-term and/or synergistic effects.

5.2.2 What are the Regions of Influence?

To determine which other actions should be included in a cumulative impacts analysis, the regions of influence must first be defined. These regions should not be limited to only the geographic areas of resources addressed by Alternatives B and C, but they should also take into account the distances that cumulative impacts may travel and the regional characteristics of the affected resources.

Because this PEIS addresses allocating public and NFS lands as open and closed to geothermal leasing and amending land use plans at a programmatic level, the region of influence for each resource evaluated by the cumulative impacts analysis is, unless otherwise noted, the 12-state project area. Of all the geothermal uses, commercial electrical generation would have the greatest impacts (see Chapter 4). In general, most commercial electrical generation in the near term would occur in northern Nevada, northeastern and southern California, Oregon, Idaho, and along the Cascade mountain range.

5.2.3 What is the Time Frame of the Action Alternatives?

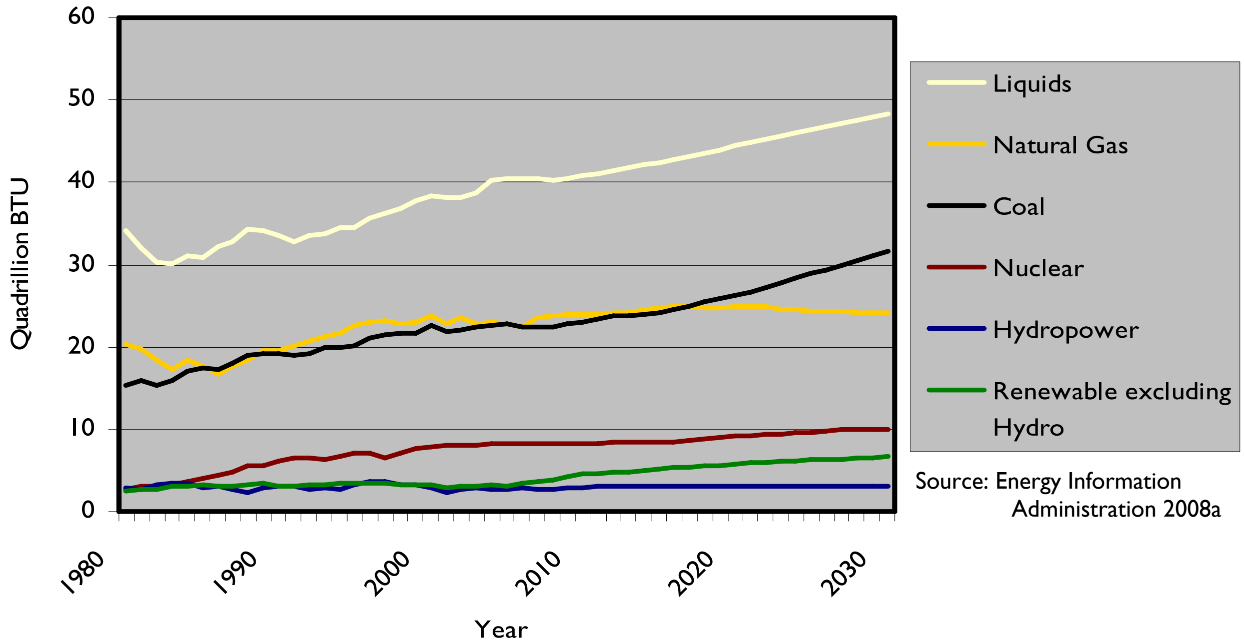
The time frame of the cumulative impact analysis incorporates the sum of the effects of anticipated future actions consistent with the implementation of Alternatives B and C in combination with other past, present, and future actions, because impacts may accumulate or develop over time. The future actions described in this analysis are those that are "reasonably foreseeable;" that is, they are ongoing (and will continue into the future), are funded for future implementation, or are included in firm near-term plans. The reasonably foreseeable time frame for future actions evaluated in this cumulative analysis is 20 years from the allocation of lands available for geothermal leasing and completion of land use plan amendments. While it is difficult to project reasonably foreseeable future actions (or trends) beyond a 20-year time frame, it is acknowledged that the effects identified in the cumulative impacts analysis will likely continue beyond the 20-year horizon.

5.2.4 What are the Reasonably Foreseeable Future Actions?

Reasonably foreseeable future actions include projects, activities, or trends that could impact human and environmental receptors within the defined regions of influence (Section 5.2.3) and within the defined time frame (Section 5.2.4). The reasonably foreseeable future actions in this section consider other uses on all lands in the 12-state project area regardless of land ownership. The data include public and NFS lands and do not specifically break out public and NFS lands.

Trends in energy supply and demand are affected by many factors that are difficult to predict, such as energy prices, US and worldwide economic growth, advances in technologies, and future public policy decision both in the US and in other countries (Energy Information Administration 2007b). Figure 5-1 depicts US energy consumption by fuel type from 1980 through present, and predicts future energy consumption trends through 2030.

Figure 5-1
US Energy Consumption by Fuel Type from 1980 – 2030
(Quadrillion Btu)



5.3 What are the Types of Major Actions?

The following section provides a description of the types of major actions and trends occurring on federal and nonfederal lands in the project area.

5.3.1 Oil and Gas Exploration, Development, and Production

Oil and gas provides 62 percent of the nation's energy and almost 100 percent of its transportation fuels (BLM 2005c). The majority (over 60 percent) of oil and gas consumed in the US is imported.

Natural Gas

The US consumes approximately 21.6 billion cubic feet of natural gas annually, accounting for 22 percent of the nation's total energy consumption (Energy Information Administration 2008f). Of total US consumption, approximately 19 percent is imported (Energy Information Administration 2008f). Table 5-1 shows natural gas production in the project area between 2001 and 2006. During this period, gas production increased in half of the ten project area states with such production, and it decreased in the other half. This resulted in an overall increase in project area gas production by almost seven percent. This is higher than the US average, which decreased by about four percent during the same six-year period. Gas production increased significantly in Colorado (47.1 percent), Montana (39.4 percent), and Wyoming (29.2 percent) (Energy Information Administration 2008c).

Table 5-1
Annual Natural Gas Production in the Project Area, 2001–2006 (million cubic feet)

	Gas Production (mmcf) [1]						
State	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Percent Change**
US Total	**24,500,779**	**23,941,279**	**24,118,978**	**23,969,678**	**23,456,822**	**23,507,471**	**-4.1%**
Alaska	3,427,779	3,477,438	3,578,305	3,644,084	3,642,948	3,205,751	-6.5%
Arizona	307	301	443	331	233	611	99.0%
California	414,838	397,021	368,440	348,827	352,044	349,137	-15.8%
Colorado	825,378	945,659	1,021,294	1,089,622	1,143,985	1,214,396	47.1%
Idaho	0	0	0	0	0	0	0.0%
Montana	81,802	86,424	86,431	97,838	108,555	114,037	39.4%
Nevada	7	6	6	5	5	5	-28.6%
New Mexico	1,712,390	1,655,906	1,616,179	1,644,738	1,656,850	1,619,528	-5.4%
Oregon	1,112	837	731	467	454	621	-44.2%
Utah	301,422	293,063	284,359	290,586	311,994	356,038	18.1%
Washington	0	0	0	0	0	0	0.0%
Wyoming	1,634,987	1,747,476	1,836,115	1,929,040	2,003,826	2,111,766	29.2%
Project Area Total	**8,400,022**	**8,604,131**	**8,792,303**	**9,045,538**	**9,220,894**	**8,971,890**	**6.8%**

[1] MMCF = million cubic feet

Source: Energy Information Administration 2008b

Crude Oil

The US consumes almost 20.7 million barrels (707 million gallons) of crude oil per day, accounting for 40 percent of the nation's total energy consumption, the largest share of any fuel type (US Government Printing Office 2008, Energy Information Administration 2008f). Of the total US consumption, almost 60 percent is imported (Energy Information Administration 2008f). In 2006, the 12 western states that make up the project area accounted for approximately 37 percent of the crude oil supply produced in the US. Table 5-2 shows crude oil production in the project area between 2001 and 2006. During this period, crude oil production decreased in six of the nine project area states with such production, resulting in an overall decrease of oil production for the project area by almost 13 percent. This is slightly greater than the US average, which decreased by about 12 percent during the same six-year period. Oil production increased significantly in Colorado (41.6 percent), Montana (127.8 percent), and Utah (17.4 percent) (Energy Information Administration 2008c).

Table 5- 2
Annual Crude Oil Production in the Project Area, 2001–2006 (in thousand barrels)

	Oil Production (bbl)[1]						
State	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Percent Change**
US Total	2,117,511	2,097,124	2,073,453	1,983,302	1,890,106	1,862,259	-12.1%
Alaska	351,411	359,335	355,582	332,465	315,420	270,486	-23.0%
Arizona	59	63	47	52	50	55	-6.8%
California	260,663	258,010	250,000	240,206	230,294	223,449	-14.3%
Colorado	16,520	17,734	21,109	22,097	22,823	23,390	41.6%
Idaho	0	0	0	0	0	0	0.0%
Montana	15,920	16,855	19,320	24,724	32,855	36,262	127.8%
Nevada	572	553	493	463	447	426	-25.5%
New Mexico	68,001	67,041	66,130	64,236	60,660	59,818	-12.0%
Oregon	0	0	0	0	0	0	0.0%
Utah	15,252	13,676	13,096	14,629	16,651	17,910	17.4%
Washington	0	0	0	0	0	0	0.0%
Wyoming	57,433	54,717	52,407	51,619	51,626	52,904	-7.9%
Project Area Total	**785,831**	**787,984**	**778,184**	**750,491**	**730,826**	**684,700**	**-12.9%**

[1] (bbl) = Barrel: A unit of volume equal to 42 US gallons
Source: Energy Information Administration 2008c

Factors associated with oil and gas exploration that can produce impacts may include:

- Exploratory drilling;
- Construction of well pads;
- Well installation;
- Spills/releases;
- Pipeline and utility corridors;
- Access roads and helipads;
- Compressor stations; and
- Site reclamation and rehabilitation.

Factors associated with oil and gas production that can produce impacts may include:

- Production and processing plants;
- Refineries;

- Carrier pipelines;
- Spills/releases;
- Power plants; and
- Access roads.

Oil Shale

Oil shale is a sedimentary rock that releases petroleum-like liquid when heated. The mining and processing of oil shale is more complex and expensive than conventional oil recovery; however, increasing oil prices and advances in technology are making it a more feasible energy option (US DOE and BLM 2007). Over 50 percent of the world's oil shale resource estimate is from the US (BLM 2005c). The Green River Formation, a geologic unit that underlies portions of Colorado, Utah, and Wyoming in the project area, contains the largest oil shale deposits with an estimated 1.5 trillion barrels of oil (BLM 2005c). The federal government owns approximately 72 percent of the US acreage containing oil shale deposits (BLM 2005c). The BLM is currently preparing a PEIS analyzing the amendment of land use plans in Colorado, Utah, and Wyoming, to allow BLM to consider applications to lease oil shale and tar sands for development (BLM 2007m). Factors associated with oil shale mining and processing that can produce impacts may include:

- Surface mines;
- Underground mines;
- In situ retorting;
- Processing plants (rock crushing and retorting);
- Refineries;
- Solid waste (overburden, waste rock, spent shale, and tailings); and
- Site reclamation and rehabilitation.

In September 2008, the BLM published a Final PEIS for a commercial leasing program for oil shale and tar sands resources on public lands, with an emphasis on the most geologically prospective lands in Colorado, Utah, and Wyoming. The proposed land use plan amendments analyzed as the preferred alternative in the PEIS would make 1,991,222 acres of lands containing oil shale resources available for application for commercial leasing (Bureau of Land Management 2008k).

Tar Sand Deposits

Tar sand deposits comprise another oil-yielding resource under western federal land, primarily in eastern Utah. These deposits are a combination of clay, sand, water, and bitumen that can be mined and processed to produce oil (US DOE and BLM 2007). Deposits could yield 40 to 76 billion barrels of oil (BLM 2005c).

The BLM is currently preparing an PEIS analyzing the amendment of land use plans in Colorado, Utah, and Wyoming, to allow BLM to consider applications to lease oil shale and tar sands for development (BLM 2007m). Factors associated with tar sands mining and processing that can produce impacts may include:

- Surface mines;
- Underground mines;
- In situ recovery (e.g., steam injection);
- Extraction plants;
- Solid waste (overburden, waste sand, spend sand, tailings);
- Refineries; and
- Site reclamation and rehabilitation.

In September 2008, the BLM published a Final PEIS for a commercial leasing program for oil shale and tar sands resources on public lands, with an emphasis on the most geologically prospective lands in Colorado, Utah, and Wyoming. The proposed land use plan amendments analyzed as the preferred alternative in the PEIS would make 431,224 acres of lands containing tar sands resources available for application for commercial leasing (Bureau of Land Management 2008k).

5.3.2 Coal and Other Mineral Exploration, Development, and Production (Extraction)

Factors associated with coal and other mineral exploration and development that can produce impacts may include exploratory drilling and trenching and access road and helipad construction. Factors associated with coal and other mineral production (extraction) that can produce impacts may include:

- Surface mines;
- Underground mines;
- Access roads;
- Processing (beneficiation) plants;
- Transportation (e.g., railroads);
- Solid waste (overburden, waste rock, and tailings); and
- Site reclamation and rehabilitation.

Leasable Minerals, Including Coal

Leasable minerals include oil and gas; oil shale; geothermal resources; coal; potash; phosphate; sodium; native asphalt; gilsonite; sulfur in New Mexico; gold, silver, and quicksilver in certain private land claims; and silica deposits in certain parts of Nevada (BLM 2006c). They are leased on public lands under the Mineral Leasing Act of 1920. Leases to these resources on public lands are obtained through a competitive bidding process.

Coal

The US produces approximately 1.2 million short tons and consumes approximately 1.1 million short tons of coal annually, accounting for almost 23 percent of the nation's total energy consumption (Energy Information Administration 2008f). Wyoming is the largest coal-producing state. In the US, coal is used almost exclusively to generate electricity, and coal plants account for over 53 percent of all US electricity generation (BLM 2005c). Table 5-3 shows coal production in the project area in 2000 and 2006. During this period, coal production decreased in five of the eight project area states that produce coal. However, this was offset by substantial increases in Colorado (almost 25 percent) and Wyoming (almost 32 percent), resulting in an overall increase in coal production in the project area by almost 23 percent. This is four-fold greater than the US average, which increased by about eight percent during that same six-year period (Energy Information Administration 2008d, 2008e).

Table 5-3
Coal Production in the Project Area, 2000–2006 (million short tons)

State	2000	2006	Percent Change
US Total	**1,073.6**	**1,162.8**	**8.31%**
Alaska	1.6	1.4	-12.50%
Arizona	13.1	8.2	-37.40%
California	0	0	0.00%
Colorado	29.1	36.3	24.74%
Idaho	0	0	0.00%
Montana	38.4	41.8	8.85%
Nevada	0	0	0.00%
New Mexico	27.3	25.9	-5.13%
Oregon	0	0	0.00%
Utah	26.7	26.1	-2.25%
Washington	4.3	2.6	-39.53%
Wyoming	338.9	446.7	31.81%
Project Area Total	**479**	**589**	**22.86%**

Source: Energy Information Administration 2008d, 2008e

In the project area, there are seven states containing coal leases on public or NFS lands (Alaska, Colorado, Montana, New Mexico, Utah, Washington, and Wyoming). In these seven states, there are 269 coal leases covering 429,976 acres on public or NFS lands (BLM 2005c). Total short tons of coal produced from these lands totals 10.2 quadrillion Btus (BLM 2005c).

Locatable Minerals

The BLM administers mineral estate on almost 700 million acres of lands in the US, including its own lands, as well as other lands, such as NFS lands. Economic production of mineral resources on these lands includes locatable, leasable, and salable solid minerals.

Locatable minerals can be obtained by filing a mining claim and include both metallic minerals (e.g., gold, silver, lead) and nonmetallic minerals (e.g., fluorspar, asbestos, mica, gemstones). They are defined under the General Mining Law of 1872. Locatable minerals are those that are neither leasable minerals nor saleable mineral materials. Hardrock (locatable) minerals include, but are not limited to, copper, lead, zinc, magnesium, nickel, tungsten, gold, silver, bentonite, barite, feldspar, fluorspar, and uranium (BLM 2006c). In 2007, there were 341,012 active mining claims on file with the BLM, with the highest number (197,843) in Nevada (BLM 2006c). This represents a 70-percent increase from 2006 and a 50-percent increase from 2001 (US DOE and BLM 2007).

Saleable Mineral Materials

Saleable mineral materials include common varieties of sand, gravel, stone, pumice, pumicite, cinders, and ordinary clay. Use of salable minerals on public lands requires either a sales contract or a free use permit. The BLM may issue free use permits to a government agency or a nonprofit organization. The Forest Service administers the disposal of salable minerals from NFS lands.

5.3.3 Renewable Energy Development

Renewable energy resources are naturally replenished in a relatively short period of time and include geothermal energy, hydropower, solar energy, wind energy, and biomass. Renewable energy is used for electricity generation, heat in industrial processes, heating and cooling buildings, and transportation fuels. In 1850, about 90 percent of energy consumed in the US was from renewable energy resources. Now the US is heavily reliant on nonrenewable fossil fuels: coal, natural gas, and oil. In 2006, almost seven percent of all energy consumed, and about nine percent of total electricity production, was from renewable energy sources. In 2004, electricity generation accounted for about 70 percent of total renewable energy consumption. Industrial process heat and building space heating accounted for 25 percent of renewable energy use, and the remainder was used as vehicle fuels (Energy Information Administration 2008g, 2008i).

Geothermal Energy

Chapter 1 describes geothermal energy generation and use.

Hydroelectric Power

Hydropower is the largest renewable energy source used by the electric power sector. In 2006, the US consumed 2.9 quadrillion Btu of conventional hydroelectric power, approximately 42 percent of all renewable energy consumption (US Government Printing Office 2008). It is used almost exclusively to generate commercial electricity. Factors associated with hydropower energy development that can produce impacts may include dams and diversion structures and generating stations.

Solar

Solar energy can be converted into other forms of energy, such as heat and electricity. In 2004, about one percent of all renewable energy consumed in the US was from solar energy sources (Energy Information Administration 2008i). In 2004, over 90 percent of solar energy was consumed by the residential sector (Energy Information Administration 2008g). Factors associated with solar energy development that can produce impacts may include vegetation clearing, fencing around the solar collecting facilities, construction activity, access roads, and transmission lines.

The BLM is preparing a PEIS for solar energy development on BLM-administered lands in six western states (Arizona, California, Colorado, New Mexico, Nevada, and Utah). Similar to the geothermal PEIS, the solar energy PEIS supports the amendment of land use plans to designate lands that are available for solar development and lands that would be excluded from such development, and to adopt a comprehensive list of best management practices and procedures to serve as consistent guidance for future solar energy development. The solar PEIS will provide an RFD scenario to define the potential for future utility-scale solar energy development activities over a 20-year study period. The RFD scenario will include an estimate of the acres of disturbance associated with the likely development.

The Energy Information Administration estimates that solar electrical generation in the United States, not including off-grid photovoltaics, will increase from 0.05 gigawatts (GW) of capacity in 2008 to 0.30 GW of capacity by 2025 (Energy Information Administration 2008a). Assuming a land area requirement of 10 acres per MW for photovoltaics, this increase in capacity would cover a land area of 2,500 acres. The expansion of renewable energy projects in the US has been rapidly increasing in 2008, and it is therefore expected that the estimates given above are greatly understated. For example, in August 2008, the Pacific Gas and Electric Company in California agreed to purchase power from a new photovoltaic power project covering 8,000 acres and generating 800 MW (0.8 gigawatts) of capacity. This single project is greater than the Energy Information Administration's projected 2025 power generation capacity. With the recent rapid expansion of investment and interest in renewable energy, it is difficult to project what acreage will be devoted to solar development over the coming years.

Wind

Wind energy is mainly used to generate electricity. In 2004, just over two percent of all renewable energy consumed in the US was from wind energy sources (Energy Information Administration 2008i). In 2004, all wind energy was consumed by the electric power sector (Energy Information Administration 2008g). Factors associated with wind energy development that can produce impacts may include:

- Vegetation clearing and excavation;
- Construction of meteorological towers;
- Construction and operation of turbine towers;
- Access roads;
- Electrical substations and transformer pads; and
- Ancillary facilities (e.g., control building and sanitary facilities).

In 2005, the BLM published a PEIS supporting the establishment of a Wind Energy Development Program to support wind energy development on BLM-administered lands and to minimize potential environmental and sociocultural impacts associated with that development. The PEIS addressed 1) an assessment of wind energy development potential on BLM-administered lands through 2025 (a 20-year period); 2) policies regarding the processing of wind energy development right-of-way (ROW) authorization applications; 3) best management practices (BMPs) for mitigating the potential impacts of wind energy development on BLM-administered lands; and 4) amendments of specific BLM land use plans to address wind energy development. The wind PEIS covered BLM-administered lands in the 11 western states (the same project area as the geothermal PEIS, except for Alaska) and identified an estimated 160,100 acres of land that are economically developable (Bureau of Land Management 2005a).

Biomass

Biomass is organic material made from plants and animals and contains stored energy from the sun. Examples of biomass fuels are wood, crops, manure, and some garbage. When burned, the chemical energy in biomass is released as heat. In 2004, approximately 46 percent of all renewable energy consumed in the US was from biomass/waste energy sources (Energy Information Administration 2008i). In 2004, biomass/waste energy was consumed by several sectors, including electric power, industrial (electric and nonelectric), commercial, residential, and transportation (Energy Information Administration 2008g). Factors associated with biomass energy development that can produce impacts may include harvesting, access roads, transmission lines, and air pollution.

5.3.4 Nuclear Electric Power

A nuclear power plant operates by producing heat by fissioning or splitting uranium atoms. That heat boils water to make steam that turns a turbine-generator. Nuclear power accounts for approximately eight percent of the nation's total energy consumption (Energy Information Administration 2008f) and about 19 percent of the total electricity generated in the US (Energy Information Administration 2008j).

5.3.5 Transmission and Distribution Systems

Rights-of-way for electric, oil, and gas transmission, as well as roads, telephone/telegraph lines, water pipelines, and communication sites, cross multiple federal and nonfederal lands in the project area. Federal agencies authorized to grant rights-of-way for electric, oil, and gas transmission include the BLM, FS, National Park Service (electric only), USFWS, US Bureau of Reclamation, and US Bureau of Indian Affairs. About 90 percent of the oil and gas pipeline and electricity transmission rights-of-way in the western states cross federal lands, the majority of which are managed by the BLM or FS (National Energy Policy Development Group 2001). The demand for additional energy and electricity is projected to increase the number of rights-of-way across public and NFS lands in the years to come (National Energy Policy Development Group 2001). Factors associated with utility corridors that can produce impacts may include:

- Carrier pipelines;
- Oil and gas pipelines;
- Fuel transfer stations;
- Spills/releases;
- Transmission lines;
- Substations; and
- Access roads.

In 2007, the BLM and the Department of Energy released a Draft PEIS analyzing the designation of energy corridors on Federal land in the 11 western states (the same western states as examined in this geothermal PEIS, except for Alaska). The proposed corridors have a total surface area of about 2.9 million acres, and approximately 61 percent (3,713 miles) of the total miles (6,055 miles) of proposed corridors follow or incorporate existing transportation or utility ROWs (US DOE and BLM 2007).

5.3.6 Transportation

Transportation systems in the project area are extensive and include interstate and US highway system roads, county roads, bridges, tunnels, Indian reservation roads, defense access roads, federal lands roads, and public authority-owned roads serving federal lands. Railways also transport commodities such as coal. Factors associated with transportation facilities development that can produce impacts may include:

- Highways, roads, and parkways;
- Railroads (coal transport); and
- Hazardous material releases.

5.3.7 Major Uses of Federal and Nonfederal Land

Major uses of federal and nonfederal land that can include factors that may produce impacts include:

- Forest land;
- Grassland pasture and rangeland;
- Cropland;
- Special uses (parks and wildlife areas);
- Other uses (including commercial); and
- Urban land.

As shown in Table 5-4, the major uses of federal and nonfederal land in the US in 2002 were forest-use land, grassland pasture and rangeland, cropland, special uses (parks and wildlife areas), miscellaneous other uses, and urban land. Much of the land (32 percent) in the 12-state project area is used as grassland pasture and rangeland, followed by forest-use land (26 percent) and special uses (almost 21 percent) (USDA, Economic Research Service 2008).

Table 5-4
Major Land Uses by State in 2002 (in 1,000 acres)

State	Crop land[1]	Grassland pasture and range[2]	Forest-use land[3]	Special uses[4]	Urban	Other land[5]	Total land in 12-state project area[6]
Alaska	90	1,295	90,475	143,262	167	130,760	366,049
Arizona	1,235	40,533	17,608	11,373	1,080	897	72,726
California	10,655	21,729	33,780	21,558	5,095	6,997	99,814
Colorado	12,044	28,158	18,925	6,022	814	417	66,380
Idaho	6,408	20,984	16,824	6,175	263	2,305	52,958
Montana	18,118	46,361	19,184	6,863	168	2,458	93,153
Nevada	884	46,448	8,636	6,882	367	7,088	70,289
New Mexico	2,671	51,676	14,978	6,449	484	1,410	77,668
Oregon	5,311	23,239	27,169	3,946	662	1,112	61,438
Utah	2,044	24,339	14,905	4,958	444	5,882	52,572
Washington	7,983	7,369	17,347	6,839	1,367	1,682	42,588
Wyoming	2,860	44,323	5,739	6,416	109	2,697	62,144
Total	70,303	356,454	285,570	230,743	11,003	163,705	1,117,779
Percentage of Total Project Area	**6.29%**	**31.89%**	**25.55%**	**20.64%**	**0.98%**	**14.65%**	

Source: USDA, Economic Research Service 2008

[1] Total acreage in the crop rotation.

[2] Grassland and other nonforested pasture and range in farms excluding cropland used only for pasture, plus estimates of open or nonforested grazing land not in farms.

[3] Excludes an estimated 98 million forest acres in parks and other special uses of land.

[4] Transportation, recreation, and other special uses of land.

[5] Areas in miscellaneous uses not inventoried, and marshes, open swamps, bare rock areas, desert, tundra, and other land generally of low value for agricultural purposes.

[6] Approximate land area established by the Bureau of the Census in conjunction with the 2000 *Census of Population and Housing*.

5.3.8 Grazing and Rangeland Management

As shown in Table 5-5, grazing land is comprised of grassland pasture and rangeland, cropland, and forest land-grazed. In 2002, grazing land comprised about 43 percent of the 12-state project area's land (USDA, Economic Research Service 2008). Cropland pasture is the smallest, but generally the most productive, component of grazing acreage, accounting for less than one percent of the project area. New Mexico, Wyoming, and Nevada have the greatest percentage of grazing land. Factors associated with livestock grazing that can produce impacts may include resource conservation (during nonuse periods) and rangeland improvements (e.g., water pipelines, reservoirs, and fences).

Table 5-5
Grazing Land by State in 2002 (in 1,000 acres)

State	Cropland Pasture	Grassland and other pasture and range	Forest land grazed	Total Grazing Land	Percent of Total Land Area
Alaska	9	1,295	147	1451	0.40%
Arizona	214	40,533	11,709	52456	72.13%
California	1,345	21,729	12,070	35144	35.21%
Colorado	1,835	28,158	10,516	40509	61.03%
Idaho	770	20,984	4,432	26186	49.45%
Montana	1,726	46,361	6,620	54707	58.73%
Nevada	314	46,448	6,887	53649	76.33%
New Mexico	837	51,676	9,482	61995	79.82%
Oregon	1,003	23,239	11,558	35800	58.27%
Utah	602	24,339	9,596	34537	65.69%
Washington	499	7,369	3,879	11747	27.58%
Wyoming	913	44,323	3,543	48779	78.49%
Total	**10,067**	**356,454**	**90,439**	**456,960**	**43.29%**

Source: USDA, Economic Research Service 2008

5.3.9 Fire Management and Timber Production

Prescribed burns are used for fire management on federal and nonfederal lands in the project area. Factors associated with fire management that can produce impacts may include access roads and air pollution.

Forest lands are managed for commercial timber production and ecological stewardship. About 33 of the US is comprised of forest land (749 million acres); of this, about one-third (246 million acres) is owned by the federal government (US DOE and BLM 2007). As shown in Table 5-6, as of 2002, about 48 percent (358 million acres) of US forest land was located in the 12-state project area. About 27 percent (137 million acres) of US timber land was located in the project area, of which about 81 million acres are federally owned (USDA, Economic Research Service 2008).

Table 5-6
Forest Land by Major Class by State in 2002 (in 1,000 acres)

State	Timberland			Reserved timber-land and other forest land[1]	Total forest land		
	Federal	Non-Federal	Total		Federal	Non-Federal	Total
Alaska	4,750	7,114	11,865	115,004	63,423	63,446	126,869
Arizona	2,438	1,089	3,527	15,901	10,192	9,235	19,427
California	10,130	7,651	17,781	22,451	22,371	17,862	40,233
Colorado	8,020	3,587	11,607	10,030	15,075	6,562	21,637
Idaho	12,596	4,227	16,824	4,823	17,129	4,517	21,646
Montana	12,506	6,679	19,184	4,108	16,512	6,781	23,293
Nevada	265	99	363	9,841	9,608	596	10,204
New Mexico	2,829	1,530	4,359	12,323	9,522	7,159	16,682
Oregon	14,194	9,637	23,831	5,819	17,741	11,910	29,651
Utah	3,586	1,097	4,683	10,994	11,913	3,764	15,676
Washington	6,104	11,244	17,347	4,443	9,422	12,369	21,790
Wyoming	4,093	1,647	5,739	5,256	8,832	2,163	10,995
Project Area Subtotal	81,511	55,601	137,110	220,993	211,740	146,364	358,103
US	**109,717**	**393,823**	**503,540**	**245,388**	**246,425**	**502,497**	**748,922**

Source: USDA, Economic Research Service 2008
[1] Includes forest land in parks, wildlife areas, and other special uses.

Major timber products include roundwood, lumber (softwood and hardwood), plywood, turpentine, rosin, pulpwood, and paperboard. Factors associated with commercial timber production that can produce impacts may include timber and vegetation harvesting and access roads.

5.3.10 Recreation

In addition to recreation visits to public and NFS lands, the public also recreated on lands managed by the National Park Service, USFWS, state wildlife agencies, state parks, and other federal, state, and local agencies. Factors associated with recreation that can produce impacts may include:

- Visiting scenic and historic places;
- Cross-country and downhill skiing;
- Hunting and fishing;
- All-terrain vehicle use;
- Camping, hiking, and picnicking;

- Viewing wildlife; and
- Scenic driving.

5.3.11 Remediation

The US EPA includes on its National Priorities List the national priorities among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the US. These sites may present a significant risk to public health and/or the environment. The National Priorities List is intended primarily to guide the US EPA in determining which sites warrant further investigation. There are 235 National Priorities List sites in the project area, with an additional 15 proposed sites. These include sites in each project area state, as follows: Alaska (five); Arizona (eight with one additional site proposed); California (94, with an additional 2 proposed); Colorado (17 with an additional three proposed); Idaho (six with an additional three proposed); Montana (14 with an additional one proposed); Nevada (one); New Mexico (13 with an additional one proposed); Oregon (12); Utah (15 with an additional four proposed); Washington (48); and Wyoming (two) (US EPA 2008e). Abandoned mine lands and hazardous material sites are the main features in the planning area associated with remediation activities that can produce impacts.

5.3.12 Population Trends

As discussed in Section 3.18, Socioeconomics, the West is the fastest growing region in the US. Between 1990 and 2006, the project area's population grew at an average rate of 1.8 percent. The largest population growth occurred in Nevada with a 4.7-percent increase, while the lowest growth occurred in Montana, with a 0.7-percent increase. Relatively high growth rates in the remaining states were estimated for Arizona (3.3 percent), Utah (2.7 percent), Idaho (2.6 percent), and Colorado (2.4 percent). Close-to-average growth occurred in New Mexico (1.8 percent), Oregon (1.8 percent), and Washington (1.7 percent), with lower-than-average growth rates in the remaining states. Factors associated with population trends that can produce impacts may include:

- Agricultural, residential, and commercial property development adjacent to federal lands;
- Urbanization; and
- Resource use (e.g., water).

5.4 What Are the Cumulative Impacts?

Neither allocating lands open or closed to geothermal leasing nor amending land use plans, as identified under Alternatives B (Proposed Action) and C, would contribute to cumulative impacts on resources or resources uses in the project area. Likewise, issuing leases itself does not cause direct impacts (see discussion in Section 4.1.1). Issuing geothermal resource leases is, however, a conditional commitment of the resource for future exploration and utilization. Therefore, an analysis of these anticipated future actions (leasing and development) consistent with implementation of the alternatives discussed in Chapter 2 is provided to assess the incremental contribution of both the proposed actions (land use plan amendment and issuing of leases) as well as other anticipated future actions associated with development of geothermal resources, when added to impacts from past, present, and reasonably foreseeable future actions throughout the project area.

While the number, variety, and magnitude of actions on public and NFS lands considered in this analysis are great, information about how many future projects may actually be undertaken is lacking, and information about the likely locations of future development is unknown. As such, the cumulative effects discussed in this section are general in nature. The resource discussions below are intended, as is appropriate in a programmatic approach, to put potential future geothermal development into context with impacts of known ongoing and planned activities, and to highlight issues that will be considered in future, site-specific NEPA actions. Unless otherwise noted, the magnitude of difference in cumulative impacts between Alternatives B and C is negligible.

5.4.1 Land Use, Recreation, and Special Designations

The contribution to cumulative impacts of geothermal projects on public and NFS lands would be small or negligible unless a significant permanent, uncompensated loss of the current productive use of a site occurred, or if other future uses were precluded. Geothermal leasing and development requires a relatively small footprint and the land required is not completely occupied by the plant. As a point of reference, based on the upper range of the RFD for geothermal electrical generation, up to 89,548 acres could be disturbed for development compared to the 17 million areas of public land that have other commercial uses (this does not include NFS lands or livestock grazing or mining activities) (BLM 2005c).

Given the small footprint, geothermal development (direct and indirect uses) is generally compatible with many other land uses, including livestock grazing; some forms of recreation; wildlife habitat conservation; and oil, gas, and wind generation. The small number of workers at a geothermal power plant (e.g., about 155 people/year during the peak construction period for a 50 MW plant, and about 20 workers during operations) would not likely add to cumulative impacts on land use or land disturbance that are occurring or have occurred from ongoing and past activities.

While geothermal is compatible with some other land uses and not all geothermal development would occur on Federal lands, it is undeniable that any power generation facility constructed where none previously existed would alter local visual and aural (auditory/sound) conditions (i.e., recreation setting), and thereby affect the recreation experience. However, given the relatively small area needed to develop geothermal operations, impacts on the recreation setting and experienced by recreation users would be minimal.

As outlined in Alternatives B and C, geothermal leasing would not be allowed for many specially designated areas, including wilderness (see Chapter 2). Some areas, such as ACECs could allow geothermal leasing. These areas have been determined to have special resource values that are compatible with controlled mineral development; hence most of these areas are also open to other fluid mineral activities. Stipulations, conditions of approval, and BMPs would minimize any impacts in these areas. Management of special designation areas is governed by site-specific management direction to protect the special resource values. This gives local authorized officers the information and discretion on how to manage leases to minimize local and cumulative impacts. Cumulative impacts would be expected in areas of high mixed mineral development (e.g., oil/gas and geothermal development); however, the collocation of these mineral sources is rare.

5.4.2 Geological Resources and Seismic Setting

Cumulative impacts on geologic resources or seismic characteristics from geothermal exploration, drilling and development are expected to be minor. Alternatives B and C include many BMPs to mitigate impacts from future drilling and earthmoving activities. Any impacts from development that might occur would be minimal and largely limited to the project site. The construction of new access roads, improvements to existing roads and bridges, and installation of wells and facilities would involve cut and fill operations. If large amounts of fill material would be necessary, increased demands on off-site supplies of sand, gravel, and crushed rock could occur. If multiple construction projects were developed within a single area, local supplies of required fill material, particularly gravel or crushed rock, could be reduced to the point of impacting the needs of roadways and other construction projects. Local changes in topography could be caused by construction of roads, well pads, pipelines, and the power plants. Cumulatively, up to 89,548 acres of land could be disturbed by geothermal development in the planning area for the next 30 years. Seismic events related to geothermal reservoir injection could cumulatively contribute to seismic events triggered by oil and gas production.

5.4.3 Energy and Minerals

An increase in development of geothermal resources would have a cumulative impact of contributing to the domestic energy supplies of the United States and of possibly reducing the demand for nonrenewable energy, such as oil, gas, and coal. According to the RFD, there is the potential to triple the megawatts produced with geothermal resources. Geothermal development could cumulatively result in competition for water rights and energy developments at the local and regional level.

5.4.4 Paleontological Resources

Disturbances from geothermal drilling and utilization, combined with other surface-disturbing development activities, could uncover or destroy paleontological resources. However, the proposed stipulations and BMPs addressing cultural resources and the proposed exclusion of many NLCS lands would limit the potential impacts. Likewise, monitoring by a qualified paleontologist would also be a site-specific requirement in areas where any excavation would occur in formations of moderate to high resource potential and would reduce any cumulative impacts.

5.4.5 Soils

Geothermal energy exploration, development, and utilization would have a minor cumulative impact on soil compaction and erosion when combined with other development projects and land uses such as livestock grazing across the Planning Area.

In total, up to 89,548 acres of land could be disturbed by geothermal development within the 12 western states over the next 30 years. Stipulations that limit siting projects in steeply sloped areas and BMPs that address stormwater runoff and fugitive dust would limit erosion-related impacts.

5.4.6 Water Resources

Drilling, well testing, construction, and geothermal production would require the consumption of water. Any additional consumption of water would have a cumulative impact when joined with other water use projects, such as agriculture, municipal wells, other energy projects, and water transfers. The actual consumption of water by energy facilities can be somewhat mitigated through water efficiency and reuse measures. There is a potential for energy facilities to concentrate in areas abundant with the particular energy resource, be it oil, gas, solar, or geothermal. In such areas, there is a greater potential to contribute to cumulative depletion of water resources. Groundwater depletion is not one of the issues addressed in the proposed lease stipulations, except indirectly through the requirement for compliance with applicable laws and regulations. The state engineer is responsible for assigning water rights and managing groundwater resources. Any added use of groundwater in areas where demand for water is nearing the available sustainable supply would contribute to cumulative impacts on groundwater. Use of closed system geothermal facilities (e.g., binary plant) with air cooling, as opposed to water cooling, would minimize any depletion as no water is directly consumed during operation.

5.4.7 Air Quality and Atmospheric Values

While geothermal energy generates minimal emissions compared to fossil fuels, the exploration, development, and operation of this renewable resource would be responsible for minor amounts of air pollutants. Most of the emissions associated with geothermal development would be during exploration, drilling, and construction activities and include particulate material (dust) and emissions from vehicles and equipment. When combined with other projects near geothermal developments, there would be a minor localized increase in emissions; however, over the long-term and across the Planning Area, geothermal electrical generation may have a beneficial cumulative impact on air quality and atmospheric values by offsetting the need for energy production that results in higher levels of emissions, such as coal, oil, and natural gas.

5.4.8 Vegetation

There would be a minor cumulative impact on vegetation from geothermal development. As a result of exploration, drilling, and utilization disturbance (including roads, transmission lines, and pipelines), there is the potential for nonnative and invasive species to colonize and dominate sites. For example, cheatgrass is a concern in much of the areas that have a high potential for geothermal development, especially in the Great Basin. The facilitation of seed dispersal could result from construction equipment transporting invasive species from the construction areas to adjacent lands along access roads and main roads. Soil compaction from machinery, vehicles, and laydown areas can limit the ability of plants to re-establish in these areas if reclamation is not conducted appropriately. In addition, exploratory drilling or uncontrolled releases, spills, seepages, or well blowouts could result in the addition of toxic, mineralized, or saline geothermal waters to the soil, streams, ponds, or wetlands. This contamination could adversely impact vegetation growth and distribution, particularly for sensitive riparian and wetland vegetation. There could be the long-term conversion of habitat types, such as from sagebrush to grassland. Many of these impacts would be minor on a site-by-site basis, but if geothermal development is consolidated with other developments that have similar effects, the cumulative impact could affect the functioning of local ecosystems.

5.4.9 Fish and Wildlife

The potential cumulative effects on vegetation would impact native fish and wildlife as habitats are fragmented, degraded, or destroyed from development. Industrial activities such as geothermal development can substantially modify or eliminate habitat within and near the development footprint, although not all species are harmed by conversion of land to more intensive uses. While the footprints of geothermal developments are relatively small, if geothermal development is consolidated with other developments that have similar effects (e.g., oil wells, wind farms, solar installations, etc.), there would be a cumulative effect via habitat fragmentation. The creation of new access roads, pipelines and transmission lines would also contribute to fragmentation and serve as a vector for invasive species. Conditions of approval and BMPs are applied at the permitting phases of geothermal development to minimize these impacts; however, fragmentation is unavoidable.

5.4.10 Threatened and Endangered Species and Special Status Species

Loss of habitat is also an important factor contributing to the increase in the number of species listed as threatened or endangered in recent years. Stipulations and permitting requirements including appropriate compliance with Section 7 of the ESA, would minimize the risk of directly taking listed species, but there could be a cumulative effect from removal of small patches of habitat that can add up to a notable acreage. Sage grouse is one special status species that could be negatively affected by extensive development due to the potential cumulative loss of habitat. Stipulations and permitting requirements would minimize this impact, but because much of the higher temperature resources are located in the Great Basin, there is likely to be some loss to sagebrush habitat.

5.4.11 Wild Horses and Burros

Cumulative impacts on wild horses and burros would occur when geothermal development projects occur along with other projects in Herd Management Areas and when both types of projects result in loss of vegetation, water supplies, Herd Management Area capacity, and the disruption of wild horses and burros practices. Geothermal developments tend to congregate in areas where there is a viable geothermal resource present. Should such conditions be discovered within Herd Management Areas, wild horses and burros could be displaced. This cumulative effect would only be realized where there is a high potential for geothermal development and there are larger populations of wild horses and burros, such as in northern Nevada.

5.4.12 Livestock Grazing

Cumulative impacts on livestock grazing would occur from the loss of forage for grazing, loss of AUM capacity, and the disruption of livestock grazing practices where geothermal development and other projects overlay grazing allotments. Geothermal developments would remove some forage, and could lower the AUM capacity in areas with livestock operations.

5.4.13 Cultural Resources

Disturbances from geothermal drilling and utilization, combined with other surface-disturbing development activities, could uncover or destroy cultural resources. However, the proposed stipulations and BMPs addressing cultural resources and the proposed exclusion of many NLCS lands would limit the potential impacts.

5.4.14 Historic and Scenic Trails

Historic and scenic trails on Federal lands are generally managed as a special designation. The proposed closure of trails to leasing and the inclusion of additional stipulations for leases near historic or scenic trails would reduce impacts on the setting of the trail system. Geothermal developments that are visible from trail sections would result in cumulative impacts when combined with other projects being developed across the Planning Area that are also visible from portions of the trail system.

5.4.15 Visual Resources

Development of geothermal resources could result in cumulative impacts on visual resources across the Planning Area when combined with other projects. The heights, type, and color of drilling equipment and power plants, together with their placement with respect to local topography (i.e., on valley floor or open basin), are factors that would contribute to determining the extent of visual intrusion on the landscape. Also, the development of transmission lines to connect new electrical production facilities to the regional power grid could contribute to cumulative impacts. Flexibility in locating power plants and other large structures to avoid cumulative impacts on important (e.g., VRM Class I or II) viewsheds should be considered during the permitting process.

5.4.16 Socioeconomic and Environmental Justice

Geothermal development projects could cumulatively contribute to beneficial socioeconomic effects across the Planning Area when combined with other projects that are also creating jobs and generating tax and royalty revenues for local, state, and Federal government.

Geothermal development projects could cumulatively contribute to adverse environmental justice effects when sited along with other industrial projects in close proximity to low-income or minority populations. Noise and air emissions (from flow testing, well venting, and blowouts) from geothermal facilities could result in health effects on nearby residents.

5.4.17 Noise

Geothermal projects are typically developed at remote locations that are away from other noise sources, where noise generated by power generation, substations, transmission lines, and maintenance activities generally approach typical background levels for rural areas at distances of 2,000 ft (600 m) or less. Therefore, the sphere of noise impact is limited in scope and would not be expected to combine with other projects and result in cumulative impacts on local residents.

5.4.18 Health and Safety

The combination of hazardous materials and other health and safety risks associated with the development and operation of geothermal energy facilities in conjunction with similar health and safety concerns for other reasonably foreseeable projects across the Planning Area is expected to be negligible. All projects would have to comply with state and federal requirements pertaining to worker safety and the use, storage, transport, and disposal of debris and hazardous materials and wastes,- thereby minimizing cumulative impacts. The potential for hazardous waste spills (fuel, drilling muds, etc.) would be minimized through the application of BMPs included in lease terms and would not be at a large enough scale to cumulatively affect human health and safety either at the local level when combined with other local projects, or across the Planning Area when combined with all other projects with similar individual effects.

5.5 What Unavoidable Adverse Impacts might be Caused by Designating Lands for Geothermal Leasing Potential and Amending Land Use Plans?

Designating lands for geothermal leasing potential, amending land use plans, and issuing leases would not result in any unavoidable adverse impacts. Subsequent development and operation of geothermal facilities could have such impacts. These impacts would be assessed during the permitting process and on a site-specific basis. If geothermal leases were developed, the following general adverse impacts would be expected:

- Long-term loss of vegetation, habitat, soil, and soil quality. The BMPs and stipulations in the PEIS would reduce some of these effects.
- Short-term and intermittent noise impacts from construction and maintenance activities. Operations would have minimal noise impacts.
- Possible loss of some recreational opportunities from energy infrastructure, although new roads could provide access for additional recreational opportunities.
- Long-term visual impact from power plants and infrastructure.
- Short-term impact on groundwater during drilling and before well casing, if drilling promotes a pathway between separate (e.g., deep and shallow) aquifers.

5.6 The Relationship Between Local Short-Term Uses of the Environment and Long-Term Productivity

This section discusses the relationship within each action alternative (Alternatives B and C) between the anticipated short-term use of the environment and the maintenance and enhancement of long-term productivity. For this PEIS, short term refers to the steps needed to develop a geothermal resource (exploration, drilling, testing, and construction). Generally it is during this time that the most extensive environmental impacts would occur. Long term refers primarily to the 20-30 year time frame considered within this PEIS. This time frame includes the production and utilization phase of a geothermal project.

The exploration and testing phase of a geothermal project is designed to determine the nature and extent of the geothermal resources. Generally, the active portion of this phase is of short duration (less than two years). Where such exploration proves unsuccessful, these lands would not be used for subsequent development and production. Instead, these lands would be restored as much as possible to their original condition upon completion of exploration and testing activities.

If geothermal activities progress beyond the exploration and testing phase into long-term productivity, the lands could be affected to a greater extent. This would depend on the degree of development (i.e., surface disturbance) and the geothermal resource potential. The short-term uses of the environment associated with anticipated future actions (i.e. exploration, drilling, land clearing, plant construction, etc.) consistent with implementation of the action alternatives are described in Chapter 2 (under Section 2.5.1 for indirect use and Section 2.5.2 for direct use) include effects on the natural environment, cultural resources, recreation, and socioeconomic resources. These short-term effects can be compared to the long-term benefits associated with the proposed action, such as clean, renewable energy production for a growing regional population and economy.

Over the long-term, while geothermal plants are in production, these new plants would be producing a low-cost, clean source of renewable energy for use in the project area and other western states. While in production, each plant would provide employment opportunities for citizens of surrounding communities. The sale of this new energy would be a new source of revenue for the counties within which the projects are located. In addition, geothermal energy development offsets the use of irretrievable resources such as coal and oil, which would result in less pollution, fewer greenhouse gas emissions, less dependence on foreign oil and gas, and a possible reduction in the trade deficit.

5.7 What Irreversible and Irretrievable Commitment of Resources would be Involved with Implementation of the Alternatives?

This section describes the irreversible and irretrievable commitments of resources associated with implementing the action alternatives (Alternatives B or C). Resources irreversibly or irretrievably committed by a proposed action are those utilized on a long-term or permanent basis. Irreversible resource commitments occur when there is unavoidable destruction of natural resources that could limit the range of potential uses of that particular environment. Irreversible commitments apply primarily to nonrenewable resources, such as cultural resources, and also to those resources that are renewable only over long periods of time, such as soil productivity or forest health.

Irretrievable resource commitments occur when an action causes the use or consumption of a resource that is neither renewable nor recoverable for future use. Irretrievable commitments apply to loss of production, harvest, or use of natural resources. These include the use of nonrenewable resources such as metal, fuel, and other natural or cultural resources considered non-retrievable, in that they would be used for the proposed action when they could have been conserved or used for other purposes.

No irreversible commitments of resources would result from amendment of land use plans or from allocating lands as open or closed to geothermal leasing. However, anticipated future development actions that may follow leasing consistent with implementation of any of the alternatives discussed in Chapter 2 could result in a variety of irreversible and irretrievable commitments of resources, as follows:

- **Hydrology and Water Quality.** Because of the large volume and long duration of geothermal fluid production, the production stage of resource development is likely to have to the greatest potential for impact on hydrologic resources. These impacts could occur in terms of changes to the hydraulics of the geothermal and groundwater reservoirs and spent geothermal fluid disposal. Hydraulic head pressures in the geothermal and adjacent groundwater reservoirs could change during production. The result could include reduction in spring discharge rates and lowering of water levels in wells. Disposal of spent fluids by injection could also affect hydraulic heads and could introduce low-quality fluids to groundwater pathways that discharge at springs or wells. This could also affect the quality of available water. Surface disposal of spent fluids could create large pools of low-quality water. Changes in spring flow and development of spent fluid-holding ponds could induce changes to wetlands-supported ecosystems and habitats. As a result, hydrologic impacts associated with geothermal development could have secondary impacts in the plant and animal community supported by natural or created wetlands.
- **Noxious Weeds.** Introduction of noxious weeds by construction and support vehicles into previously clean areas would be probable during all phases of geothermal development. The drilling and utilization phases would present the greatest opportunity for noxious weed introduction and proliferation. Once introduced, control or eradication of noxious weeds could be difficult.
- **Visual Resources.** Any changes in the characteristic landscape of the affected areas due to geothermal energy development could be visible for many years. Succession (change in habitat type over time, including the return of an area to its pre-development state after site reclamation/rehabilitation) in the Basin and Range geomorphic province is very slow due to the lack of rainfall. Rehabilitation techniques could use non-indigenous plant species, thus changing the character of the area. The degree of contrast between a reclaimed project site and its untouched surroundings would vary by area, rehabilitation techniques, and the success of those techniques. All landscapes are unique in their own right, and any change or loss of scenic values is irretrievable. Those losses become more significant in areas of unique or outstanding scenic quality.

- **Threatened, Endangered, and Special Status Species.** Loss of any species is irretrievable. Protection of threatened, endangered, and special status species is governed by federal and state statute. To minimize the effects on threatened, endangered, and special status species, the lessee would be required to complete a site-specific NEPA analysis outlining their proposed action and alternatives, and the direct and indirect impacts of their proposed action, on any threatened, endangered, and special status species prior to any occupancy and surface disturbance. Site-specific compliance with the ESA would occur at the time of development as well.
- **Geology and Minerals.** The principle commitment of resources in implementing the proposed action would be the depletion of thermal energy and water from the geothermal reservoirs tapped for energy use. To minimize this effect, the super-hot water extracted from the subterranean geothermal reservoirs through production wells is injected back into the reservoir for reheating and reuse. Over time, these resources (heat and water) could be depleted to the point that the power generating plant would no longer be economically productive.
- **Cultural Resources.** Destruction and/or loss of cultural resources are irretrievable. Federal and state statutes govern the protection of cultural resources. To minimize the effects on cultural resources, the lessee would be required to complete a site-specific NEPA analysis outlining their proposed action and alternatives, and the direct and indirect impacts of their proposed action on the cultural resources within the lease area, prior to any occupancy and surface disturbance beyond minor exploration activities.
- **Hazardous Materials/Waste and Solid Waste.** If handled improperly, hazardous materials/waste and solid waste have the potential to create irretrievable consequences. The transportation, storage, use, and disposal of hazardous materials/waste and solid waste are governed by Federal and state statute. To minimize the effects of hazardous materials/waste and solid waste, the lessee would be required to complete a site-specific NEPA analysis outlining their proposed action and alternatives, and the direct and indirect impacts of hazardous materials/waste and solid waste associated with their proposed action, prior to any occupancy and surface disturbance beyond minor exploration activities.

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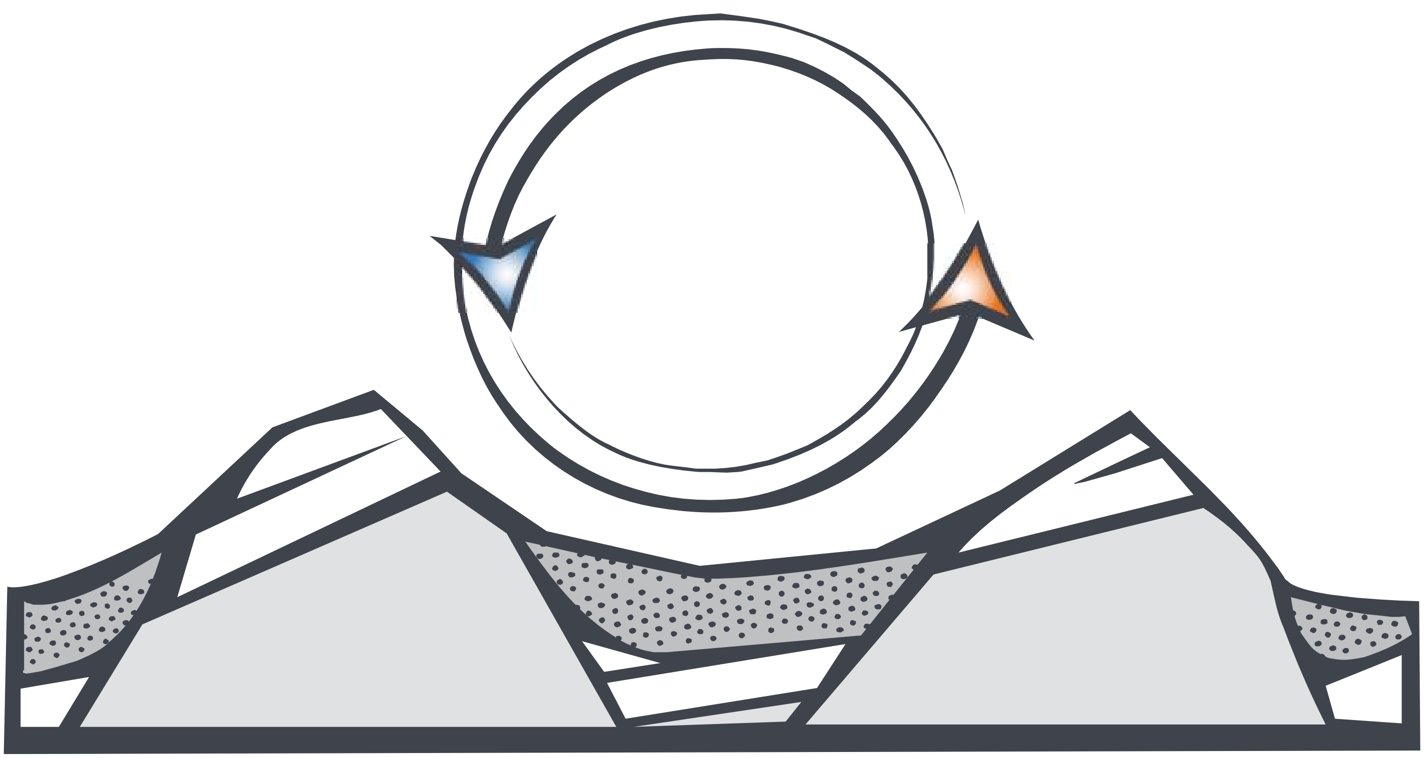

Chapter 6

Consultation and Coordination

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CHAPTER 6
CONSULTATION AND COORDINATION

6.1 PUBLIC SCOPING

The BLM published the Notice of Intent (NOI) to prepare a PEIS to evaluate geothermal leasing in the 12 western states, including Alaska, on lands administered by the BLM and the FS in the *Federal Register* (72 FR 113) on June 13, 2007. The NOI initiated the public scoping process and invited public comments on the content and issues that should be addressed in the PEIS. The BLM and the FS conducted scoping from June 13, 2007 through August 13, 2007. During that period, the BLM and the FS invited the public and interested groups to provide information and guidance, suggest issues that should be examined, and express their concerns and opinions on geothermal leasing in eleven western states and Alaska on public lands administered by the BLM and the FS. During the scoping process, the public was given four means of submitting comments to the BLM and the FS:

1. Traditional mail;
2. Toll-free facsimile transmission; and
3. Electronic mail.
4. This variety of ways to communicate issues and submit comments was provided so as to encourage maximum participation. All comments, regardless of how they were submitted, received equal consideration.

Public meetings, which were held in ten cities in July 2007: Anchorage, Alaska; Boise, Idaho; Denver, Colorado; Missoula, Montana; Phoenix, Arizona; Portland, Oregon; Reno, Nevada; Sacramento, California; Salt Lake City, Utah; and Santa Fe, New Mexico.

The scoping meetings were advertised through the following means: newspaper notices (ten newspapers); the project website; a project newsletter that was sent to approximately 1,600 recipients; electronic mail messages; newspaper articles and trade publications.

Approximately 175 people attended the scoping meetings and 101 verbal comments were identified and cataloged from these meetings. A total of 79 written comments were received in the form of comment cards submitted at the public meetings (2); letters by US Mail or by hand delivery (16); and by electronic mail (63).

The following agencies, organizations, and industries provided comments, as well as private individuals.

- California Wilderness Coalition
- Calpine Corporation
- Earth Systems Southwest
- Greater Yellowstone Coalition
- Idaho Conservation League
- New Mexico Department of Fish and Game
- Ormat, Inc.
- Save Medicine Lake Coalition
- Sierra Club, Oregon Chapter
- Skamania County Public Utility District No. 1
- Utah Environmental Congress
- Utah Office of the Governor, Utah Geological Survey
- United States Environmental Protection Agency
- Western Resource Advocates
- The Wilderness Society and Western Resource Advocates
- Wyoming Game and Fish Department
- Wyoming Outdoor Council

The BLM and FS published a scoping report on the project web site that summarized and categorized the major themes, issues, concerns, and comments expressed by private citizens, government agencies, private firms, and nongovernmental organizations. The BLM and FS considered the comments in developing the alternatives and analytical issues that are contained in this PEIS. Summaries of the individual letters, facsimiles, and electronic comments received during scoping are available within the scoping report (www.blm.gov/geothermal_eis).

6.2 Public Comment on the Draft PEIS

The United States Environmental Protection Agency published a Notice of Availability (NOA) of the Draft Programmatic Environmental Impact Statement for geothermal leasing in the 12 western states on June 20, 2008. The NOA initiated the 90-day public comment period provided for planning actions.

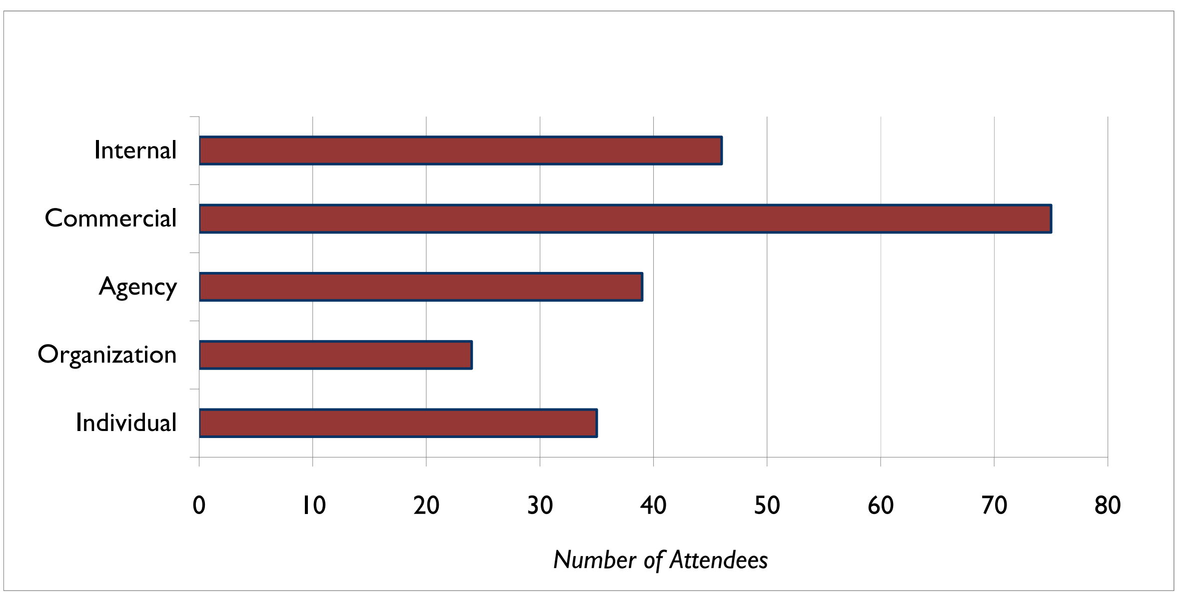
The BLM Project Web site contained the PEIS in its entirety for download. Copies of the document were sent to a mailing list of over 1,000 recipients. In addition, over 100 copies of the CD-ROM or hardcopies of the document were mailed in response to document requests. In preparing the Final PEIS, the BLM and FS considered all comments received or postmarked during the public comment period.

6.2.1 Public Meetings and Public Notification

The BLM and FS held 13 public meetings in the 12 western state project area in July 2008. Meeting locations included Albuquerque, New Mexico; Anchorage, Alaska; Boise, Idaho; Denver, Colorado; Fairbanks, Alaska; Helena, Montana; Portland, Oregon; Reno, Nevada; Sacramento, California; Salt Lake City, Utah; Seattle, Washington; and Tucson, Arizona.

Over 200 people attended the public meetings. The largest number of attendees were from the commercial/industrial sector, followed by government agencies, non-profit organizations, and non-affiliated individuals. Breakdown of attendance is presented in Figure 6-1, Public Meeting Attendees.

Figure 6-1
Public Meeting Attendees



Internal-FS and BLM staff, Commercial-Industry and commercial organizations, Agency-government agencies and tribal organizations, Organization- non-profit organization, Individual- no affiliation provided.

The PEIS newsletter, which provided the locations and times for the public hearings and instructions for comment submittal, was sent to those on the project mailing list and was posted on the project Web site. Public hearing times and locations were also posted directly on the Web site and were printed in local newspapers for each city where a meeting was held.

In addition, notices were published to inform the public about the analysis of pending lease applications on FS lands. Notices were published in August 2008 in the following papers, identified as the Newspapers of Record for the affected FS offices:

- Modoc NF: Modoc County Record, Alturas, California
- Mt Hood NF: The Oregonian, Portland, Oregon
- Willamette National Forest: Register-Guard, Eugene, Oregon
- Mt. Baker-Snoqualmie National Forest: Seattle Post-Intelligencer, Seattle, Washington
- Humboldt-Toiyabe NF: Reno Gazette-Journal, Reno, Nevada
- Tongass National Forest: Ketchikan Daily News, Ketchikan, Alaska

6.2.2 Summary of Comments

The comment period closed on September 19, 2008. All written comments sent prior to midnight (12:00 AM on September 20, 2008) were accepted as official comments. Methods of submitting comments included letters, facsimiles, and electronic mail messages. All comments, regardless of how they were submitted, received equal consideration.

Over 70 organizations, government agencies, industry representatives, and individuals responded during the comment period. Most of the written submissions contained multiple comments on different topics, and over 500 unique comments were made. All information received through these comments has been evaluated, verified, and incorporated into the Final PEIS, as appropriate. Copies of all accepted written submissions are provided in Appendix L, and the BLM and FS response to each separate comment follows the comment letter.

Comments on the PEIS pertained to a number of issues, including but not limited to scope of the document, identification of lands available for leasing, and incorporation of site-specific stipulations and BMPs. In addition, comments were received for the following resources and resource uses: air quality, cultural resources, fish and wildlife, geologic resources and seismic setting, livestock grazing, land use and special designations, minerals and energy, noise, national scenic and historic trails, recreation, socioeconomics and environmental justice, special status species, tribal interests, vegetation, visual resources, and water resources.

6.3 Government-to-Government Consultation

The BLM and the FS are working on a government-to-government basis with Native American tribes. As a part of the government's treaty and trust responsibilities, the government to government relationship was formally recognized by the federal government on November 6, 2000, with E.O. 13175, "Consultation and Coordination with Indian Tribal Governments," (U.S. President 2000).

The BLM and FS coordinate and consult with tribal governments, Native communities, and tribal individuals whose interests might be directly and substantially affected by activities on BLM- and FS-administered lands. These agencies strive to provide the tribal entities sufficient opportunities for productive participation in BLM and FS planning and resource management decision making.

The BLM and FS developed a process to offer specific consultation opportunities to "directly and substantially affected" tribal entities, as required under the provisions of E.O. 13175. Letters were mailed in September 2007 to each tribal executive official of over 400 tribes and pueblos in the western US and Alaska from the Deputy Director of the BLM and Deputy Chief of National Forest Systems of the FS (Table 6-1). The letters documented the PEIS process and detailed the pending lease applications that are being assessed in the PEIS, and invited them to participate in the consultation process. Seven tribes provided a response letter. One letter noted that no lease applications were in their area of interest, four letters requested consultation if any lease applications would fall in their areas of interest, and two letters requested consultation and to help participate in the PEIS process.

The Draft PEIS was sent to an updated list of over 400 tribes and pueblos in the western US and Alaska. Follow-up contacts were made with the two tribes that had requested consultation on the PEIS, along with another tribe with interests in multiple states. Of these, one tribe was not interested in direct government-to-government consultation at this time; one tribe is considering requesting a meeting; and the third tribe is working with the BLM and FS to schedule a formal government-to-government consultation meeting. Local BLM and FS officials are coordinating ongoing government-to-government consultation for the pending leases, as described in Volume II.

6.4 Coordination of BLM and FS Offices

This PEIS was prepared by the BLM and the FS to evaluate a program that will have BLM- and FS-wide impacts. Weekly conference calls were held to brief BLM and FS staff and to enhance coordination among the project team, the BLM State and District offices, and the FS offices. In addition, the project team presented in-person briefings to both regional and headquarters' staff as requested. Coordination with State Office and Field Office staff will continue on issues related to geothermal leasing on BLM- and FS-administered lands through the completion of the project.

6.5 Agency Cooperation, Consultation, and Coordination

From the start of this PEIS process, the BLM and the FS consulted with several federal agencies regarding the purpose and need for the proposed action and the scope of the analysis. The US Department of Energy participated on the project core team. The US Geological Survey also worked closely with the core team to provide technical guidance in defining areas of geothermal development potential for electrical generation. The BLM and FS are also coordinating with the US Environmental Protection Agency regarding air quality, wetlands, and other natural resources.

The BLM and FS are coordinating with and soliciting input from the State Historic Preservation Offices and the Advisory Council on Historic Preservation in accordance with the National Historic Preservation Act. This PEIS provides for a phased consultation process related to historic, traditional, and cultural resources.

Dialogues have been initiated with key state agencies involved in the promotion, analysis, and permitting of geothermal development projects including state geological surveys, state energy offices, and state energy regulatory bodies. Coordination with research institutes, universities, and stakeholders groups, including business and geothermal industry groups is ongoing.

In addition, the BLM initiated activities to coordinate and consult with the governors of each of the 12 states and with state agencies. Prior to the issuance of the ROD and the approval of proposed plan amendments, the governor of each state will be given the opportunity to identify any inconsistencies between the proposed plan amendments and state or local plans and to provide recommendations in writing.

6.6 Endangered Species Act - Section 7

6.6.1 Section 7 Requirements

Section 7 of the Endangered Species Act (ESA) directs each Federal agency, in consultation with the Secretary of the Interior and the Secretary of Commerce, as appropriate, to ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any listed threatened or endangered species or result in the destruction or adverse modification of critical habitat[1].

[1] See ESA § 7; 16 USC 1536. The standard for determining when Federal agencies must consult under the ESA is different from the standard for determining when Federal agencies must prepare an Environmental Impact Statement under the National Environmental Policy Act.

Under Section 7 of the ESA, those agencies that authorize, fund, or carry out a Federal action are commonly known as "action agencies." If an action agency determines that its Federal action "may affect" listed species or critical habitat, it must consult with the USFWS of the DOI or the National Marine Fisheries Service (NMFS) of the Department of Commerce (DOC) (collectively known as the "Services") or both, whichever has jurisdiction over the species or habitat that may be affected[2].

If an action agency determines that the Federal action will not cause any effects on listed species or critical habitat, the action agency does not initiate consultation with the Services, and its obligations under Section 7 are complete. In order to make this determination, an action agency must consider the effects of the action at issue. Regulations implementing NEPA and ESA each use the terms "direct effect," "indirect effect," and "cumulative effect," but the definitions of these terms are not identical under the statutes. Regulations at 40 CFR 1508.8 and 50 CFR 402.02 highlight these differences. Under NEPA, and as demonstrated in this PEIS, an agency will examine the direct, indirect, and cumulative impacts of a proposed action. Indirect effects are those caused by the action, later in time, and *reasonably foreseeable*. Under the ESA, however, the effects of an action are evaluated by a stricter standard. Regulations implementing the ESA define the term "effects of an action" at 50 CFR 402.02 to include direct and indirect effects (and the effects of interrelated or interdependent activities), but limit indirect effects to those that are caused by the action, later in time, and *reasonably certain* to occur. In addition, ESA regulations limit the term "cumulative effects" to those effects of future state or private activities; NEPA regulations are not so limited.

The "reasonably certain to occur" standard used in the ESA regulations is more demanding than the "reasonably foreseeable" standard used in the NEPA regulations (see 40 CFR 1508.8). Thus, it is possible that a proposed action may have "no effect" under the ESA standard but will have multiple effects under NEPA. The ESA standard has been part of interagency regulations at 50 CFR Part 402 since 1986 and is the subject of proposed rules recently promulgated by FWS and NMFS[3].

6.6.2 Agency Status under ESA Section 7

The DOI (BLM) and USDA (Forest Service) have concluded that they are action agencies for ESA purposes because each manages Federal land where leasing and development of geothermal resources may take place. In particular, the BLM is an action agency for purposes of the land use plan amendments to allocate land as available for leasing, as analyzed in this PEIS; decisions to be made regarding pending lease applications, as analyzed in Volume II of this PEIS; and future lease

[2] See 50 CFR 402.02, 402.13-14.

[3] Interagency Cooperation Under the Endangered Species Act, 73 Fed. Reg. 47868 (Aug. 15, 2008) (to be codified at 50 CFR pt. 402).

applications that may be submitted. As the FS will be making decisions appropriate to their respective management authority regarding these pending lease applications, the FS, too, is an action agency for ESA purposes.

6.6.3 "No Effect" Determination under Section 7

In complying with their duties under Section 7 of the ESA, the action agencies have examined the effects on listed species and critical habitat both of allocating land as available for leasing of geothermal resources through land use plan amendments, and of issuing leases for these resources. As a result of this examination, the action agencies have determined that neither of these actions (amending land use plans; issuing geothermal leases) would cause any effect on a listed species or on critical habitat. This determination is based on the following.

Allocation Decisions Do Not Cause Effects on Species or Habitats

The first proposed action, allocation of BLM-administered lands with geothermal resource potential as closed, open, or open with major or moderate constraints to geothermal leasing, through amendment of land use plans, fulfills BLM's obligations under FLPMA and would not cause any impact, direct or indirect, as cognizable under the ESA, to listed species or critical habitat. The land use plan amendments identify and allocate such areas, adopt RFDs, and adopt a list of stipulations, best management practices, and procedures to be applied for the protection of resources.

This proposed action does not establish a precedent or create any legal right that would allow ground-disturbing activities within any of these areas allocated for geothermal leasing. Following lease issuance, when an application to conduct activities involving surface disturbance is submitted that could affect a listed species or critical habitat at a particular location within one of these areas, it would be subject to full policy and legal review at the time it is filed. This includes review and coordination under the ESA and other applicable statutes of the applicability of the stipulations, best management practices, and procedures for the protection of other resources.

Similarly, providing suitability information to facilitate the FS' subsequent consent decision to the BLM for leasing on NFS lands to the FS, to the extent this providing of information could be construed to be an action under ESA, is an administrative task that would not cause any impact, direct or indirect, as cognizable under the ESA, to listed species or critical habitat.

Lease Issuance Does Not Cause Effects on Species or Habitats

The decision to issue a lease is a separate and discretionary decision from the allocation decision made through land use plan amendment. With respect to the pending lease applications analyzed in Volume II, BLM has determined that the issuing of a geothermal lease similarly does not cause any effect on listed species or critical habitat under the ESA. Moreover, there is no guarantee that any particular authorization or lease will be granted, or, even if granted, as explained below, that any development will ever take place on such lease.

This second proposed action, therefore, to complete processing of active pending lease applications and nominations by deciding whether, and under what stipulations, to issue geothermal leases on NFS and public lands, is an action that, in itself, and on the condition that the stipulation addressing ESA matters is incorporated in any lease issued, would not cause any impact, direct or indirect, as cognizable under the ESA, to listed species or critical habitat. Lease rights are always limited by the requirements of other laws, as illustrated in the geothermal regulations at 43 CFR 3200.4.

As explained in Section 2.2.2 of the PEIS, in accordance with BLM Instruction Memorandum No. 2002-174, the BLM will apply the following ESA-related stipulation on any leases where threatened, endangered, or other special status species or critical habitat is known or strongly suspected:

> "The lease area may now or hereafter contain plants, animals, or their habitats determined to be threatened, endangered, or other special status species. BLM may recommend modifications to exploration and development proposals to further its conservation and management objective to avoid BLM-approved activity that will contribute to a need to list such a species or their habitat. BLM may require modifications to the lease terms or disapprove proposed activity that is likely to result in jeopardy to the continued existence of a proposed or listed threatened or endangered species or result in the destruction or adverse modification of a designated or proposed critical habitat. BLM will not approve any ground-disturbing activity that may affect any such species or critical habitat until it completes its obligations under applicable requirements of the Endangered Species Act as amended, 16 USC 1531 et seq., including completion of any required procedure for conference or consultation."

Additionally, the BLM will provide a separate notification through a lease notice to prospective lessees identifying the particular special status species that are present on the lease parcel offered. For agency-designated sensitive species (e.g., sage grouse), a lease stipulation (NSO, CSU, or TL) would be imposed for those portions of high value/key/crucial species habitat where other existing measures are inadequate to meet agency management objectives.

Moreover, even without the ESA-related stipulation, lease issuance, by itself, does not afford lessees the right to engage in any ground-disturbing activity. Under the regulations applicable to geothermal development, permits, with associated environmental reviews and coordination, are required at every stage of exploration, drilling, and utilization before the applicant may proceed. Even before lease issuance, pre-leasing exploration cannot take place without approval, which may include protective "Conditions of Approval" (43 CFR 3251.10). The geothermal regulations include prohibitions such as "Do not start activities that will result in surface disturbance until we approve your drilling permit and Sundry Notice" (43 CFR 3261.14). Similar language appears in relation to the regulations that correspond to each stage of geothermal development, including the sections related to drilling (43 CFR 3261.11(b)), utilization, and site licenses: "Do not begin site investigations…" (43 CFR 3271.12(b)); "Do not start construction of pipelines…" (43 CFR 3271.13); "Do not start delivery of geothermal resources to a facility…" (43 CFR 3271.14(b)); "Do not start building or testing your facility…" Each of these stages provides the BLM with opportunities to decide whether the next stage should be approved, denied, or approved with conditions such as protective measures. See, for example, 43 CFR 3273.12 (e). Each subpart also contains general standards and environmental requirements. See, for example, 43 CFR 3260.11 and 3272.12. Moreover, the agencies must verify that leasing on the applicant's parcel has been adequately addressed in a NEPA document. Using the ESA stipulation above, as well as the many distinct decision points described in the geothermal development regulations, the agencies have retained the authority post-lease issuance to condition, and even to deny, the use of the leased property if required by the ESA. Therefore, even the decision to lease does not result in any effect on listed species or critical habitat. For this reason, the agencies have made a "no effect" determination for the proposed allocation decisions in the land use plan amendments, as well as for the decision to issue leases.

It is important to note that the effects of any future development-stage activities that might occur subsequent to the issuance of a lease would be allowed only following additional site-specific compliance with ESA and other applicable laws, and are not included in the scope of this action. Thus, the effects of development-stage activities are not to be considered effects, direct or indirect, caused by the proposed action (lease issuance) at issue here. The regulations governing geothermal leasing and development provide for several decision stages prior to any ground-disturbing activities taking place and contemplate further compliance with applicable authorities during these decision stages. Therefore, both under the regulatory scheme, and as a practical matter, until BLM receives an application for a permit to drill, or other authorization, which includes specific information about particular projects (i.e., location, scale, technology, etc.), and adjudicates it, it is impossible to determine what effects on listed species or critical habitat might be "reasonably certain to occur" (see 50 CFR Part 402). It is at that time that consultation under Section 7 with NOAA or the FWS may be appropriate and useful.

For the above reasons, the action agencies have determined that amending land use plans to allocate areas as available for geothermal leasing, providing information for later FS decision-making, and issuing geothermal leases would have no effect on listed threatened or endangered species or critical habitat.

The action agencies reach their "no effect" determination not because listed species and critical habitat are unlikely to be present. To the contrary, Appendix H of the PEIS identifies numerous listed species that occur in the 12 western states where land use plans will be amended, and leases may be issued. Areas that may eventually be leased would likely include areas occupied by listed species or within critical habitat.

The action agencies considered preparing a biological assessment and initiating consultation with USFWS and NMFS under Section 7(a)(2). After discussing various approaches, the action agencies determined that the administrative actions of allocating lands as available for leasing of geothermal resources and issuing leases for these resources would have no effect on listed species or critical habitat. Preparing a biological assessment before a site-specific application for permit to drill has been filed with BLM would be based largely on conjecture and speculation. There would be no way to know before such a site-specific proposal is made whether the impacts to be assessed would be from one or another specific type of geothermal plant or facility, or associated transmission line, etc., or some combination of uses. Further, without knowing the specifics of when and where a project would occur, it would be impossible to know what species, if any, would be affected by these future projects. The agencies considered whether it made sense to make assumptions for the purposes of a biological assessment, but were left with no credible basis on which to make such assumptions. The agencies determined such assumptions would be speculative and not linked to the Federal action of allocating lands as available for geothermal leasing through land use plan amendments, or even issuing such leases. Any biological assessment would be a speculative assessment of effects from future site-specific projects, not of the proposed actions addressed in this PEIS as a whole.

This is not to say that there would be no Section 7 consultations (including preparation of biological assessments or biological opinions where appropriate) on future actions that may affect listed species or critical habitat. On the contrary, as explained above, the action agencies fully expect that Section 7 compliance, including consultations if necessary, will be appropriate as applications for permits to drill on particular leaseholds are submitted for decision-making by the BLM, with FS concurrence, as necessary. That is, if an application for a permit, or other authorization is received by an action agency for lands allocated as open for leasing, further compliance with Section 7 of the ESA would be initiated at that time.[4] This may take the form of preparation of a biological assessment by the action agencies and issuance of a biological opinion by USFWS and/or NMFS; a "may affect, not likely to adversely affect" determination by the action agencies with Service concurrence; or a "no effect"

[4] Further, if a future, site-specific proposal may adversely affect essential fish habitat (EFH), the action agencies would consult with NMFS, as required by the Magnuson Stevens Fishery Conservation and Management Act, 16 USC l855(b)(2), prior to approval.

determination by the action agencies. At such time, any biological assessment, biological opinion, concurrence, or "no effect" determination would be based on a detailed application describing the project, site, and method of construction – all features lacking at the present time.

In reaching their "no effect" determination, the action agencies found no causal connection, whether direct or indirect, between the mere allocation of areas as available for geothermal leasing (through land use plan amendment), or issuance of such leases, and any effect on a listed species or critical habitat. Allocation of areas as available for leasing of geothermal resources neither guarantees that a lease within such an area will be granted, nor, even if a lease is granted (assuming that the ESA stipulation is incorporated in such lease) that an application for a permit to drill will be granted. Any effects to a listed species or critical habitat that might occur in any of the areas allocated through this planning action or lease issuance in the future are simply unknown at this time and, in any event, would be caused by the grant of a permit, or other site-specific authorization, following full policy and legal review, including compliance (and consultation if appropriate) under Section 7 of the ESA.

6.7 POTENTIAL ADOPTION OF THE PEIS BY OTHER ORGANIZATIONS

The PEIS provides an analysis of the positive and negative environmental, social, and economic impacts associated with geothermal leasing on BLM-administered and NFS lands in the western United States and Alaska. It identifies potential measures that may be undertaken to avoid, mitigate, or minimize potential impacts and proposes specific policies and BMPs to govern geothermal leasing. The information contained in the PEIS and the decisions represented in the proposed policies and BMPs may be relevant to geothermal leasing on other lands, including other Federal, private, state-owned, and tribal lands. They may also be relevant to decisions regarding other related activities, including development of new transmission lines, substations, and other facilities.

Other agencies may elect to adopt this PEIS, or a portion of this PEIS, at some time in the future. The CEQ regulations provide specific guidance on the process by which one agency can adopt another agency's final environmental document even though it did not participate as a cooperating agency (40 CFR 1506.3). According to the CEQ in its March 23, 1981 "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," Question 30, "If the proposed action for which the EIS was prepared is substantially the same as the proposed action of the adopting agency, the EIS may be adopted as long as it is recirculated as a final EIS and the agency announces what it is doing. This would be followed by the 30-day review period and issuance of a Record of Decision by the adopting agency. If the proposed action by the adopting agency is not substantially the same as that in [46 FR 18036] the EIS (i.e., if an EIS on one action is being adapted for use in a decision on another action), the EIS would be treated as a draft and circulated for the normal public comment period and other procedures" (46 FR 55, 18026-18038).

Individual organizations should consider their own NEPA implementing regulations or comparable programmatic requirements to evaluate the potential benefits associated with implementation of all or portions of the PEIS.

Table 6-1
Consultation Invitation Letter Mailing List

Agdaagux Tribe of King Cove
Agua Caliente Band of Cahuilla Indians
Ak Chin Indian Community Council
Akiachak Native Community (IRA)
Akiak Native Community (IRA)
Alatna Village
Aleut Community of St. Paul Island
Algaaciq Native Village
Allakaket Village
Alturas Rancheria
Angoon Community Association (IRA)
Anvik Village
Arapaho Business Committee
Arctic Village Council
Asa'carsarmiut Tribe
Atqasuk Village
Augustine Band of Mission Indians
Barona Band of Mission Indians
Battle Mountain Band Council
Bear River Band of Rohnerville Rancheria
Beaver Village Council
Benton Paiute Reservation
Berry Creek Rancheria
Big Lagoon Rancheria
Big Pine Paiute Tribe of the Owens Valley
Big Sandy Rancheria
Big Valley Rancheria
Birch Creek Tribal Council
Bishop Paiute Tribe
Blackfeet Tribal Business Council
Blue Lake Rancheria
Bridgeport Indian Colony
Buena Vista Rancheria
Burns Paiute Tribe, General Council
Cabazon Tribal Business Committee
Cahto Tribal Executive Committee
Cahuilla Band of Mission Indians
California Valley Miwok Tribe
Campo Band of Mission Indians
Carson Community Council
Cedarville Rancheria
Central Council Tlingit & Haida Indian Tribes of Alaska
Chalkyitsik Village Council
Cheesh-Na Tribal Council
Chemehuevi Tribal Council
Chenega IRA Council
Chevak Native Village
Chickaloon Native Village
Chicken Ranch Rancheria
Chignik Lagoon Council
Chignik Lake Village Council
Chilkat Indian Village (Klukwan) (IRA)
Chilkoot Indian Association (IRA)
Chinik Eskimo Community
Chippewa Cree Business Committee
Chitina Traditional Indian Village Council
Chuloonawick Native Village
Circle Native Community (IRA)
Cloverdale Rancheria
Cocopah Tribal Council
Coeur d'Alene Tribal Council
Cold Springs Rancheria
Colorado River Tribal Council
Colusa Rancheria
Colville Business Council
Confederated Salish & Kootenai Tribes, Tribal Council
Confederated Tribes of Coos, Lower Umpqua and Siuslaw Indians
Confederated Tribes of the Chehalis Reservation
Confederated Tribes of the Grand Ronde Community of Oregon
Confederated Tribes of the Umatilla Indian Reservation
Confederated Tribes of the Warm Springs Reservation, Tribal Council
Coquille Indian Tribe
Cortina Rancheria

Cow Creek Government Offices
Cowlitz Indian Tribe
Coyote Valley Reservation
Craig Community Association (IRA)
Crow Tribal Council
Curyung Tribal Council
Douglas Indian Association (IRA)
Dresslerville Community Council
Dry Creek Rancheria
Duckwater Tribal Council
Egegik Village
Eklutna Native Village
Ekwok Village
Elem Indian Colony
Elim IRA Council
Elk Valley Rancheria
Elko Band Council
Ely Shoshone Tribal Council
Emmonak Village
Enterprise Rancheria
Evansville Village
Ewiiaapaayp Band of Kumeyaay Indians
Fallon Paiute Shoshone Tribal Business Council
Federated Indians of Graton Rancheria
Fort Belknap Community Council
Fort Bidwell Reservation
Fort Hall Business Council
Fort Independence Reservation
Fort McDermitt Tribal Council
Fort McDowell Yavapai Tribal Council
Fort Mojave Tribal Council
Fort Peck Tribal Executive Board
Gambell IRA Council
Gila River Indian Community Council
Goshute Business Council
Greenville Rancheria
Grindstone Rancheria
Guidiville Rancheria
Gulkana Village
Habematolel Pomo of Upper Lake
Havasupai Tribal Council
Healy Lake Village
Hoh Tribal Business Committee
Holy Cross Village
Hoonah Indian Association (IRA)
Hoopa Valley Tribal Council
Hopi Tribal Council
Hopland Reservation
Hualapai Tribal Council
Hughes Village
Huslia Village Council
Hydaburg Cooperative Assn. (IRA)
Igiugig Village
Inaja-Cosmit Reservation
Inupiat Community of Arctic Slope (IRA)
Ione Band of Miwok Indians
Iqurmiut Traditonal Council
Ivanoff Bay Village Council
Jackson Rancheria
Jamestown S'Klallam Tribal Council
Jamul Indian Village
Jicarilla Apache Nation
Kaguyak Village
Kaibab Paiute Tribal Council
Kaktovik Village
Kalispel Business Committee
Kaltag Tribal Council
Karuk Tribe of California
Kenaitze Indian Tribe (IRA)
Ketchikan Indian Community Tribal Council
King Island Native Community (IRA)
King Salmon Tribe
Klamath General Council
Klawock Cooperative Association
Knik Village
Kobuk Traditional Council
Kokhanok Village
Kongiganak Traditional Council
Kootenai Tribal Council
Koyukuk Native Village
La Jolla Band of Luiseno Indians
La Posta Band of Mission Indians
Larsen Bay Tribal Council
Las Vegas Tribal Council
Lesnoi Village, Woody Island Tribal Council
Levelock Village
Lime Village Traditional Council
Lone Pine Paiute Shoshone Reservation
Los Coyotes Band of Cahuilla & Cupeno Indians
Louden Tribal Council
Lovelock Tribal Council
Lower Elwha Tribal Council
Lower Lake Rancheria
Lummi Indian Business Council
Lytton Rancheria
Makah Indian Tribal Council
Manchester - Point Arena Band of Pomo Indians
Manley Hot Springs Village
Manokotak Village
Manzanita Band of Mission Indians

Mary's Igloo Traditional Council
McGrath Native Village Council
Mechoopda Indian Tribe of the Chico Rancheria
Mentasta Lake Tribal Council
Mesa Grande Band of Mission Indians
Mescalero Apache Tribe
Metlakatla Indian Community
Middletown Rancheria
Moapa Business Council
Mooretown Rancheria
Morongo Band of Mission Indians
Muckleshoot Tribal Council
Naknek Native Village
Native Village of Afognak
Native Village of Akhiok
Native Village of Akutan
Native Village of Aleknagik
Native Village of Ambler
Native Village of Atka
Native Village of Barrow Inupiat Traditional Government
Native Village of Belkofski
Native Village of Bill Moore's Slough
Native Village of Brevig Mission
Native Village of Buckland (IRA)
Native Village of Cantwell
Native Village of Chignik
Native Village of Chuathbaluk
Native Village of Council
Native Village of Crooked Creek
Native Village of Deering (IRA)
Native Village of Diomede (IRA) (aka Inalik)
Native Village of Eagle (IRA)
Native Village of Eek
Native Village of Ekuk
Native Village of Eyak
Native Village of False Pass
Native Village of Fort Yukon (IRA)
Native Village of Gakona
Native Village of Georgetown
Native Village of Goodnews Bay
Native Village of Hamilton
Native Village of Hooper Bay
Native Village of Kanatak (IRA)
Native Village of Karluk (IRA)
Native Village of Kasigluk
Native Village of Kiana
Native Village of Kipnuk
Native Village of Kivalina (IRA)
Native Village of Kluti-Kaah (aka Copper Center)
Native Village of Kotzebue (IRA)
Native Village of Koyuk (IRA)
Native Village of Kwigillingok
Native Village of Kwinhagak (IRA)
Native Village of Marshall
Native Village of Mekoryuk (IRA)
Native Village of Minto (IRA)
Native Village of Nanwalek (aka English Bay)
Native Village of Napaimute
Native Village of Napakiak (IRA)
Native Village of Napaskiak
Native Village of Nikolski (IRA)
Native Village of Noatak (IRA)
Native Village of Nuiqsut
Native Village of Nunam Iqua
Native Village of Nunapitchuk (IRA)
Native Village of Ouzinkie
Native Village of Paimiut
Native Village of Perryville Tribal Council
Native Village of Pitka's Point
Native Village of Point Hope (IRA)
Native Village of Point Lay (IRA)
Native Village of Port Heiden
Native Village of Savoonga (IRA)
Native Village of Shaktoolik (IRA)
Native Village of Shishmaref (IRA)
Native Village of Shungnak (IRA)
Native Village of South Naknek
Native Village of St. Michael (IRA)
Native Village of Stevens (IRA)
Native Village of Tanana (IRA)
Native Village of Tatitlek (IRA)
Native Village of Tazlina
Native Village of Tetlin (IRA)
Native Village of Tyonek (IRA)
Native Village of Unalakleet (IRA)
Native Village of Venetie Tribal Government (IRA)
Native Village of Wales (IRA)
Native Village of White Mountain (IRA)
Navajo Nation
Nelson Lagoon Tribal Council
Nenana Native Association
New Koliganek Village Council
New Stuyahok Village
Newhalen Village
Newtok Traditional Council
Nez Perce Tribal Executive Committee

Nightmute Traditional Council
Nikolai Village
Ninilchik Traditional Council
Nisqually Indian Community Council
Nome Eskimo Community
Nondalton Village
Nooksack Indian Tribal Council
Noorvik Native Community (IRA)
North Fork Rancheria
Northern Cheyenne Tribal Council
Northway Village
Northwestern Band of Shoshone Nation
Nulato Tribal Council
Nunakauyarmiut Tribe
Ohkay Owingeh
Ohogamuit Traditional Council
Organized Village of Grayling (IRA)
Organized Village of Kake (IRA)
Organized Village of Kasaan (IRA)
Organized Village of Kwethluk (IRA)
Organized Village of Saxman (IRA)
Orutsararmuit Native Council
Oscarville Tribal Council
Paiute Indian Tribe of Utah Tribal Council
Pala Band of Mission Indians
Pascua Yaqui Tribal Council
Paskenta Band of Nomlaki Indians
Pauloff Harbor Village
Pauma/Yuima Band of Mission Indians
Pechanga Band of Mission Indians
Pedro Bay Village Council
Petersburg Indian Association (IRA)
Picayune Rancheria of Chukchansi Indians
Pilot Point Tribal Council
Pilot Station Traditional Village
Pinoleville Reservation
Pit River Tribal Council
Platinum Traditional Village Council
Port Gamble S'Klallam Tribe
Port Graham Village Council
Port Lions Traditional Tribal Council
Portage Creek Village Council
Potter Valley Tribe
Pueblo of Acoma
Pueblo of Cochiti
Pueblo of Isleta
Pueblo of Jemez
Pueblo of Laguna
Pueblo of Nambe
Pueblo of Picuris
Pueblo of Pojoaque
Pueblo of San Felipe
Pueblo of San Ildefonso
Pueblo of Sandia
Pueblo of Santa Ana
Pueblo of Santa Clara
Pueblo of Santo Domingo
Pueblo of Taos
Pueblo of Tesuque
Pueblo of Zia
Pueblo of Zuni
Puyallup Tribal Council
Pyramid Lake Paiute Tribal Council
Qagan Tayagungin Tribe of Sand Point Village
Qawalangin Tribe of Unalaska
Quartz Valley Reservation
Quechan Tribal Council
Quileute Tribal Council
Quinault Indian Nation - Business Committee
Ramah Navajo Chapter
Ramona Band of Mission Indians
Rampart Village
Redding Rancheria
Redwood Valley Reservation
Reno-Sparks Tribal Council
Resighini Rancheria
Rincon Band of Mission Indians
Robinson Rancheria
Round Valley Reservation
Ruby Tribal Council
Rumsey Rancheria
Salt River Pima-Maricopa Indian Community Council
Samish Indian Nation
San Carlos Tribal Council
San Juan Southern Paiute Council
San Manuel Band of Mission Indians
San Pasqual Band of Diegueno Indians
Santa Rosa Band of Cahuilla Indians
Santa Rosa Rancheria
Santa Ynez Band of Mission Indians
Santa Ysabel Band of Mission Indians
Sauk-Suiattle Tribal Council
Scammon Bay Traditional Council
Scotts Valley Rancheria
Selawik IRA Council
Seldovia Village Tribe (IRA)
Shageluk Native Village (IRA)
Sherwood Valley Rancheria
Shingle Springs Rancheria

Shoalwater Bay Tribal Council
Shoshone Business Committee
Shoshone-Paiute Business Council
Siletz Tribal Council
Sitka Tribe of Alaska (IRA)
Skagway Village
Skokomish Tribal Council
Skull Valley Band of Goshute Indians General Coucnil
Sleetmute Traditional Council
Smith River Rancheria
Snoqualmie Tribal Organization
Soboba Band of Luiseno Indians
Solomon Traditional Council
South Fork Band Council
Southern Ute Tribe
Spokane Business Council
Squaxin Island Tribal Council
St. George Traditional Council
Stebbins Community Association (IRA)
Stewart Community Council
Stewarts Point Rancheria
Stillaguamish Board of Directors
Summit Lake Paiute Tribal Council
Sun'aq Tribe of Kodiak
Suquamish Tribal Council
Susanville Indian Rancheria
Swinomish Indian Tribal Community
Sycuan Band of the Kumeyaay Nation
Table Mountain Rancheria
Takotna Village
Tanacross Village Council
Telida Village
Teller Traditional Council
Te-Moak Tribe of Western Shoshone Tribal Council
Timbi-sha Shoshone Tribe
Tohono O'odham Nation
Tonto Apache Tribal Council
Torres-Martinez Desert Cahuilla Indians
Traditional Village of Togiak
Trinidad Rancheria
Tulalip Board of Directors
Tule River Reservation
Tuluksak Native Community (IRA)
Tuntutuliak Traditional Council
Tununak IRA Council
Tuolumne Rancheria
Twenty-Nine Palms Band of Mission Indians
Twin Hills Village Council
Ugashik Traditional Village Council
Umkumiut Native Village
Unga Tribal Council
United Auburn Indian Community
Upper Skagit Tribal Council
Ute Business Committee
Ute Mountain Ute Tribe
Venetie Village Council
Viejas Band of Mission Indians
Village of Alakanuk
Village of Anaktuvuk Pass
Village of Aniak
Village of Atmautluak
Village of Chefornak
Village of Clarks Point
Village of Dot Lake
Village of Iliamna
Village of Kalskag
Village of Kotlik
Village of Lower Kalskag
Village of Old Harbor
Village of Red Devil
Village of Salamatoff
Village of Stony River
Village of Wainwright
Walker River Paiute Tribal Council
Washoe Tribal Council
Wells Indian Colony Band Council
White Mountain Apache Tribe
Winnemucca Tribal Council
Wiyot Tribe
Woodfords Community Council
Wrangell Cooperative Assn. (IRA)
Yakama Nation
Yakutat Tlingit Tribe
Yavapai-Apache Community Council
Yavapai-Prescott Board of Directors
Yerington Paiute Tribe
Yomba Tribal Council
Yupiit of Andreafski
Yurok Tribe

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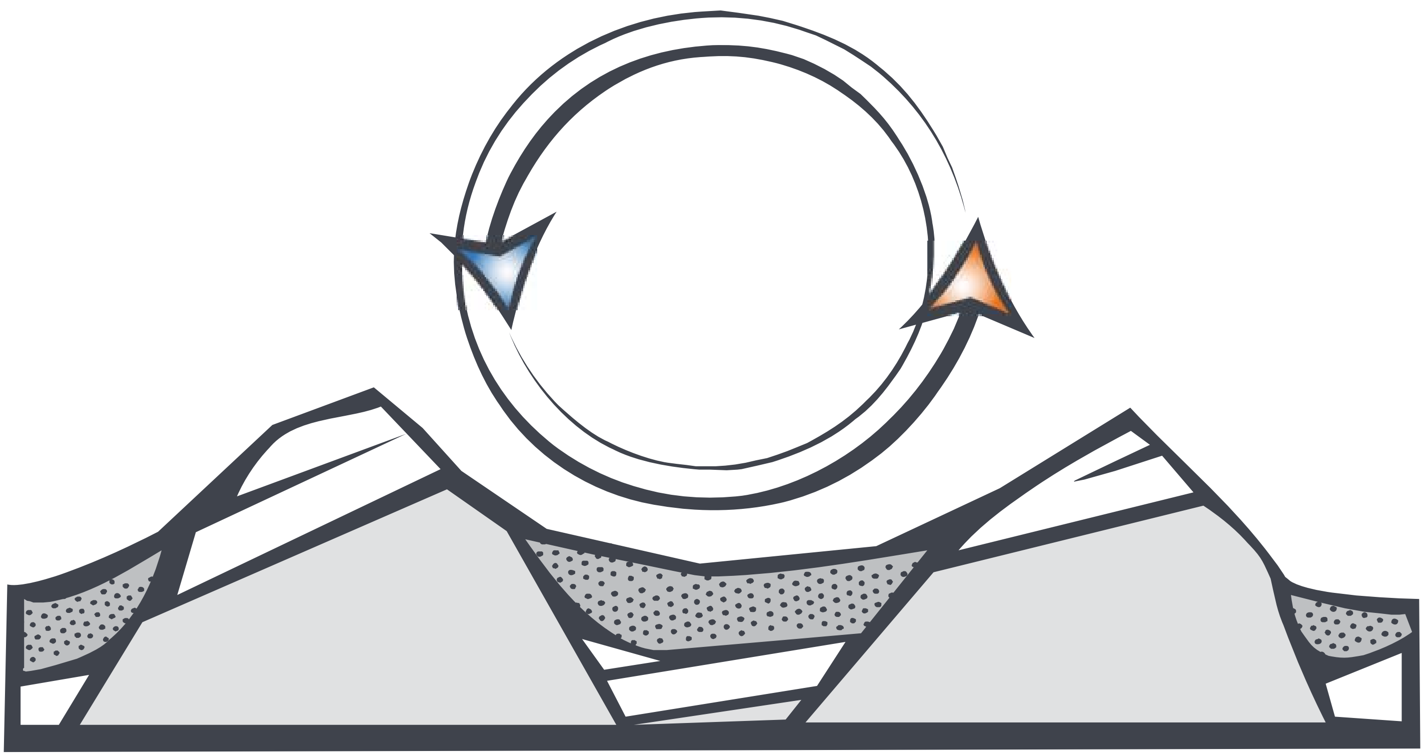

CHAPTER 7

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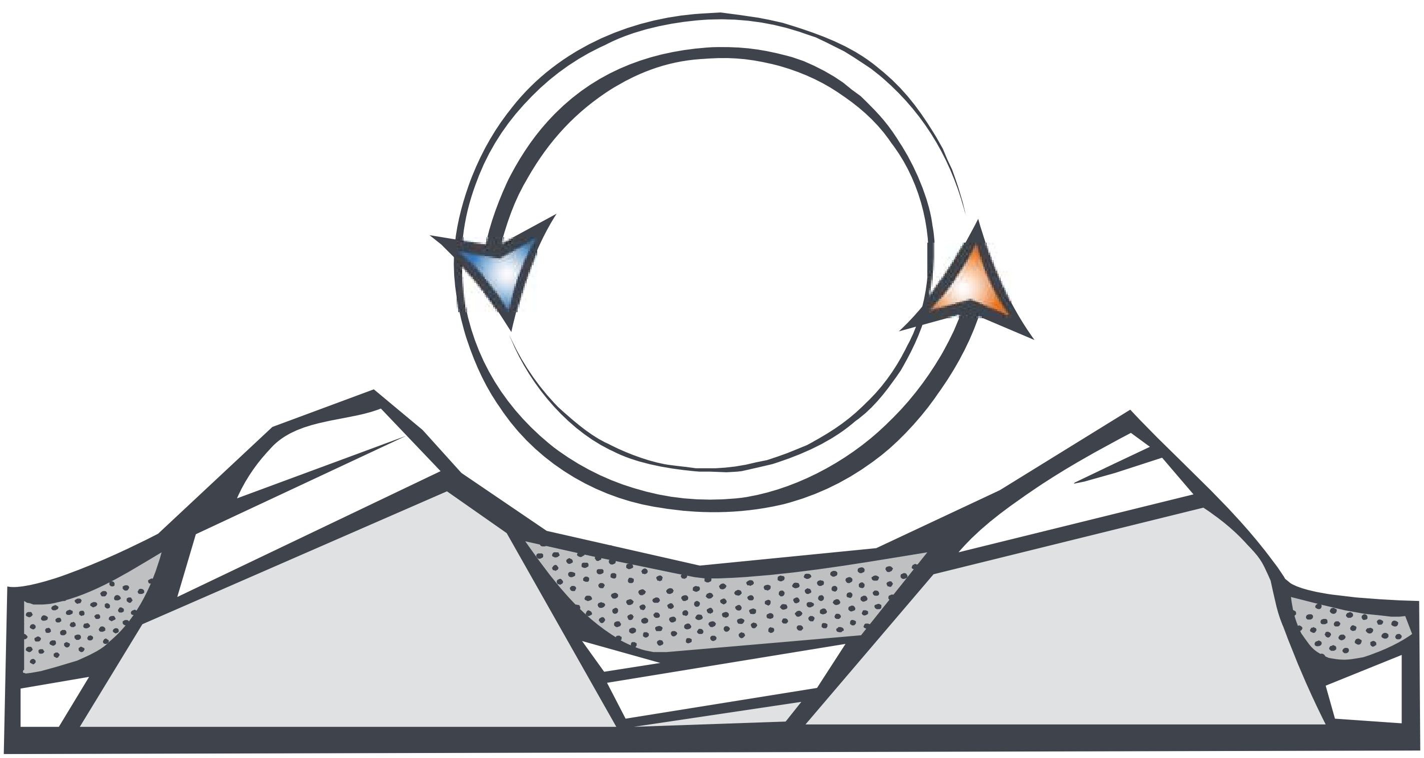

CHAPTER 8
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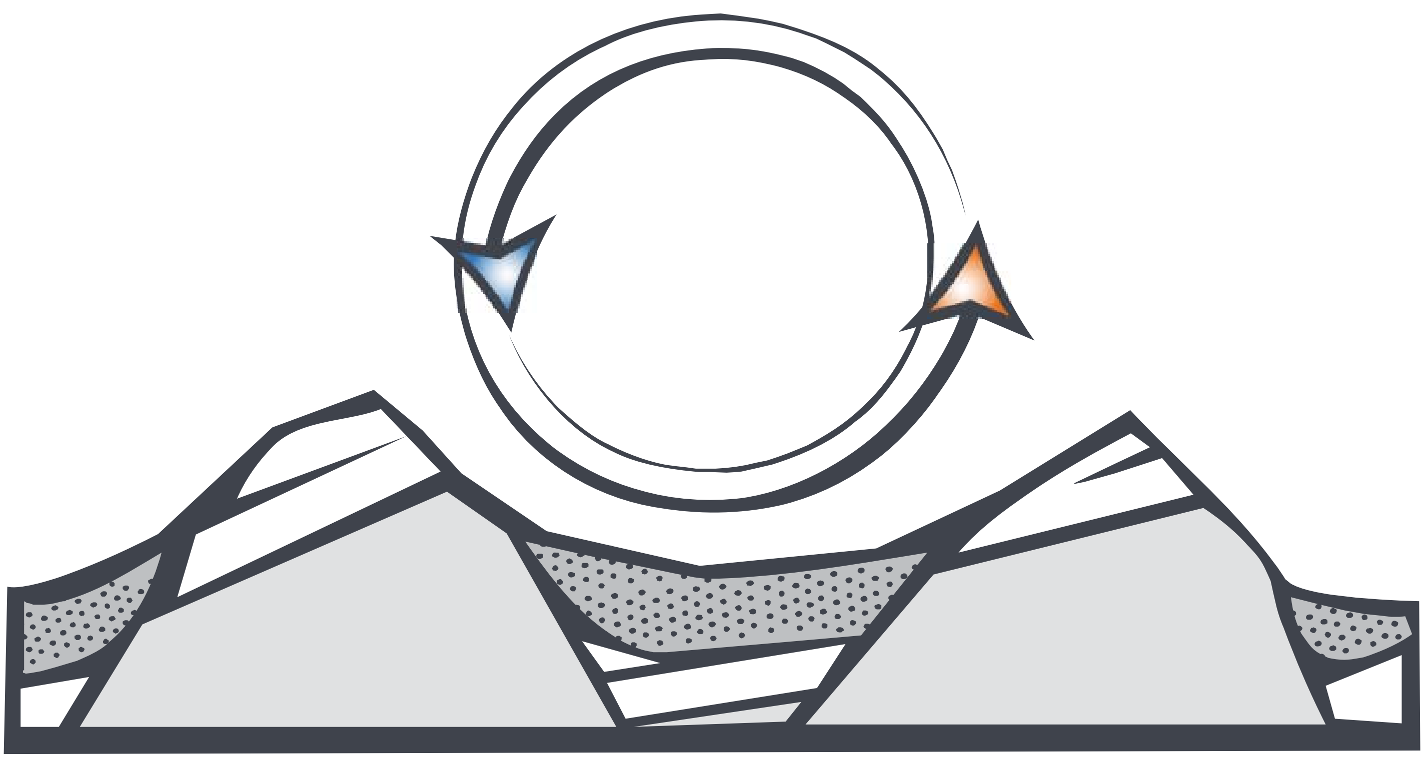

Chapter 9
Glossary

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CHAPTER 9
GLOSSARY

Aquaculture: Farming of organisms that live in water, such as fish, shellfish, and algae.

Allotment: An area of land where one or more operators graze their livestock. It generally consists of public lands but may include parcels of private or state-owned lands. The number of livestock and period of use are stipulated for each allotment.

Amendment: The process for considering or making changes in the terms, conditions, and decisions of approved RMPs using the prescribed provisions for resource management planning appropriate to the proposed action or circumstances. Usually only one or two issues are considered that involve only a portion of the planning area.

Animal Unit Month (AUM): The amount of forage necessary for the sustenance of one cow or its equivalent for a period of one month (approximately 800 pounds of air-dried material per AUM). A full AUM's fee is charged for each month of grazing by adult animals if the grazing animal: 1) is weaned, 2) is six months or older when entering public land, or 3) will become 12 months old during the period of use. For fee purposes, an AUM is the amount of forage used by five weaned or adult sheep or goats or one cow, bull, steer, heifer, horse, or mule. The term AUM is commonly used in three ways: 1) stocking rate, as in X acres per AUM, 2) forage allocation, as in X AUMs in allotment A, and 3) utilization, as in X AUMs consumed from Unit B.

Area of Critical Environmental Concern (ACEC): Special Area designation established through the Bureau's land use planning process (43 CFR 1610.7-2) where special management attention is needed to protect and prevent irreparable damage to important historical, cultural, or scenic values, fish and wildlife resources, or other natural systems or processes, or to protect life and safety from natural hazards. The level of allowable use within an ACEC is established through the collaborative planning process. Designation of an ACEC allows for resource use limitations in order to protect identified resources or values.

Assessment: The act of evaluating and interpreting data and information for a defined purpose.

Best Management Practices (BMP): A suite of techniques that guide, or may be applied to, management actions to aid in achieving desired outcomes. Best management practices are often developed in conjunction with land use plans, but they are not considered a land use plan decision unless the land use plan specifies that they are mandatory. They may be updated or modified without a plan amendment if they are not mandatory.

Biochronology: The relative dating of geologic events based on fossil evidence.

Biostratigraphy: The science of dating rocks by using the fossils contained within them. Usually the aim is correlation, that is, demonstrating that a particular horizon in one geological section represents the same period of time as another horizon at some other section. The fossils are useful because sediments of the same age can look completely different because of local variations in the sedimentary environment.

Casual use: Activities on public lands that have negligible disturbance. No notification to or approval by the authorized officer is required for casual use operations. However, casual use operations are subject to monitoring by the authorized officer to ensure that unnecessary or undue degradation of Federal lands will not occur. (43 CFR 3809)

Categorical Exclusion (CE): A category of actions (identified in agency guidance) that do not individually or cumulatively have a significant effect on the human environment, and for which neither an environmental assessment nor an EIS is required (40 CFR 1508.4)

Citizen wilderness proposal: Areas that have been inventoried and proposed for Wilderness designation by citizens.

Closed: Generally denotes that an area is not available for a particular use or uses; refer to specific definitions found in law, regulations, or policy guidance for application to individual programs. For example, 43 CFR 8340.0-5 sets forth the specific meaning of "closed" as it relates to OHV use, and 43 CFR 8364 defines "closed" as it relates to closure and restriction orders.

Collaboration: A cooperative process in which interested parties, often with widely varied interests, work together to seek solutions with broad support for managing public and other lands. This may or may not involve an agency as a cooperating agency.

Collaborative partnerships and collaborative stewardship: Refers to people working together, sharing knowledge and resources, to achieve desired outcomes for public lands and communities within statutory and regulatory frameworks.

Conformance: Means that a proposed action shall be specifically provided for in the land use plan or, if not specifically mentioned, shall be clearly consistent with the goals, objectives, or standards of the approved land use plan.

Conservation agreement: A formal signed agreement between the U.S. Fish and Wildlife Service or National Marine Fisheries Service and other parties that implements specific actions, activities, or programs designed to eliminate or reduce threats or otherwise improve the status of a species. CAs can be developed at a State, regional, or national level and generally includes multiple agencies at the State and Federal level, as well as tribes. Depending on the types of commitments the BLM makes in a CA and the level of signatory authority, plan revisions or amendments may be required prior to signing the CA, or subsequently in order to implement the CA.

Conservation strategy: A strategy outlining current activities or threats that are contributing to the decline of a species, along with the actions or strategies needed to reverse or eliminate such a decline or threats. Conservation strategies are generally developed for species of plants and animals that are designated as BLM Sensitive species or that have been determined by the Fish and Wildlife Service or National Marine Fisheries Service to be Federal candidates under the Endangered Species Act.

Consistency: Proposed land use plan does not conflict with officially approved plans, programs, and policies of tribes, other Federal agencies, and State and local governments to the extent practical within Federal law, regulation, and policy.

Controlled Surface Use (CSU) The CSU stipulation is intended for application where standard lease terms and permit-level decisions are deemed insufficient to achieve the level of resource protection necessary to protect the public interest, but where an NSO is deemed overly restrictive. A CSU stipulation allows BLM to require that a proposed facility or activity be relocated by more than 200 meters from the proposed location if necessary to achieve the desired level of protection. A CSU is not required if relocating a proposed facility or activity by up to 200 meters would be sufficient for protection of the specified resources.

Cooperating agency: Assists the lead Federal agency in developing an EA or EIS. The Council on Environmental Quality regulations implementing NEPA defines a cooperating agency as any agency that has jurisdiction by law or special expertise for proposals covered by NEPA (40 CFR 1501.6). Any tribe or Federal, State, or local government jurisdiction with such qualifications may become a cooperating agency by agreement with the lead agency

Condition of Approval (COA): A site-specific and enforceable requirement included in an approved Application for Permit to Drill (APD) or Sundry Notice that may limit or amend the specific actions proposed by the operator. Conditions of Approval minimize, mitigate, or prevent impacts to resource values or other uses of public lands.

Designated right-of-way corridor: A parcel of land, usually linear in shape, that is identified through Secretarial Order in a land use plan or by other management decision as a preferred location for existing and future rights-of-way grants.

Directional drilling: The intentional deviation of a well bore from a vertical position to reach subsurface areas off to one side from the drilling site.

Endangered species: As defined in the Federal Endangered Species Act, any species which is in danger of extinction throughout all or a significant portion of its range. For terrestrial species, the USFWS determines endangered status.

Environmental Assessment (EA): A public document for which a federal agency is responsible that serves to; (a) briefly provide sufficient evidence and analysis for determining whether to prepare an Environmental Impact Statement or a finding of no significant impact; (b) aid an agency's compliance with the National Environmental Policy Act (NEPA) when no Environmental Impact Statement is necessary; (c) Facilitate the preparation of a statement when one is necessary. An EA includes brief discussions of the need for the proposal and of the environmental impacts of the proposed action and other alternatives.

Environmental Impact Statement (EIS): A written analysis of the impacts on the natural, social, and economic environment of a proposed project or resource management plan.

Evaluation (plan evaluation): The process of reviewing the land use plan and the periodic plan monitoring reports to determine whether the land use plan decisions and NEPA analysis are still valid and whether the plan is being implemented.

Evolution: The sequence of events involved in the evolutionary development of a species or taxonomic group of organisms. In the context of the life sciences, evolution is change in the genetic makeup of a group—a population of interbreeding individuals within a species. Such a population shares a common gene pool and members exhibit a degree of genetic relatedness.

Exception: is a one-time exemption for a particular site within the leasehold; exceptions are determined on a case-by-case basis; the stipulation continues to apply to all other sites within the leasehold. An exception is a limited type of waiver.

Extinction: The disappearance of a species or group of species. The moment of extinction is generally considered to be the death of the last individual of that species.

Federal land: Land owned by the United States , without reference to how the land was acquired or which Federal Agency administers the land, including mineral and coal estates underlying private surface.

Federal Land Policy and Management Act of 1976 (FLPMA): Public Law 94-579, which gives the BLM legal authority to establish public land policy, to establish guidelines for administering such policy and to provide for management, protection, development and enhancement of the public land.

Fishery management plan: A plan developed by a Regional Fishery Management Council and the Secretary of the Department of Commerce to manage a fishery resource pursuant to the Magnuson Fishery Conservation and Management Act of 1976.

Fluvial: Pertaining to rivers, streams, and floodplains.

Fossiliferous: Fossil containing rocks.

Geographic Information System (GIS): A computer system capable of storing, analyzing, and displaying data and describing places on the earth's surface.

Geophysical exploration: Efforts to locate deposits of oil and gas resources and to better define the sub-surface.

Geothermal potential area: any area that may contain underground reservoirs of hot water or steam created by heat from the earth, or that have subsurface areas of dry hot rock.

Geothermal energy: Natural heat from within the Earth, captured for production of electric power, space heating or industrial steam.

Geothermal heat pumps: Devices that take advantage of the relatively constant temperature of the Earth's interior, using it as a source and sink of heat for both heating and cooling. When cooling, heat is extracted from the space and dissipated into the Earth; when heating, heat is extracted from the Earth and pumped into the space.

Geothermal plant: A plant in which the prime mover is a steam turbine. The turbine is driven either by steam produced from hot water or by natural steam that derives its energy from heat found in rocks or fluids at various depths beneath the surface of the Earth. The energy is extracted by drilling and/or pumping.

Guzzler: General term covering guzzler, wildlife drinker, or tenaja. A natural or artificially constructed structure or device to capture and hold rain water, and make it accessible to small and/or large animals. Most guzzlers involve above or below ground piping, storage tanks, and valves. Tenajas are natural depressions in rock, which trap and hold water. To some tenajas, steps are sometimes added to improve access and reduce mortality from drowning.

Heat pump: A heat and cooling source. Heat pumps extract heat from either the air or ground and transfer that heat by circulating a refrigerant through a cycle of alternating evaporation and condensation. The cycle can be reversed for cooling. The efficiency of an air source heat pump varies tremendously with climate while ground source heat pumps take advantage of stable ground temperatures to deliver consistent performance.

Historic resources: material remains and the landscape alterations that have occurred since the arrival of Euro-Americans.

Holotype: A holotype (sometimes simply *type*) is the single physical example or illustration of an organism that defines the characteristics of the whole species. It is the definitive member of that species. Other specimens can be compared with the holotype to determine whether they are actually a member of that species.

Implementation decisions: Decisions that take action to implement land use plan decisions. They are generally appealable to IBLA under 43 CFR 4.40.

Implementation plan: A site-specific plan written to implement decisions made in a land use plan. An implementation plans usually selects and applies best management practices to meet land use plan objectives. Implementation plans are synonymous with "activity" plans. Examples of implementation plans include interdisciplinary management plans, habitat management plans, and allotment management plans.

Indian Trust Assets (ITA): Legal interests in assets held in trust by the Federal Government for federally recognized Indian tribes or nations or for individual Indians.

Invertebrate: Animals without vertebrae (back bones) or notochord.

Isotherm: a line connecting locations with equal temperature. Isotherm maps show where temperatures are relatively high and low, and also where temperature changes are gradual or dramatic over a distance.

Known Geothermal Resource Area (KGRA): A region identified by the U.S. Geological Survey as containing geothermal resources. New leasing regulations no longer use KGRAs as a basis for the leasing process.

Lease stipulation: A condition of lease issuance that provides a level of protection for other resource values or land uses by restricting lease operations during certain times or locations or to avoid unacceptable impacts, to an extent greater than standard lease terms or regulations. A stipulation is an enforceable term of the lease contract, supersedes any inconsistent provisions of the standard lease form, and is attached to and made a part of the lease. Lease stipulations further implement the Bureau of Land Management's (BLM) regulatory authority to protect resources or resource values. Lease stipulations are developed through the land use planning process.

Land use allocation: The identification in a land use plan or land use plan amendment of the activities and foreseeable development that are allowed, restricted, or excluded for all or part of the planning area, based on desired future conditions.

Land use plan: A set of decisions that establish management direction for land within an administrative area for the BLM and FS. BLM plans are commonly called Resource Management Plans (RMPs), although older plans are called Management Framework Plan (MFP) or Management Plan. The FS has Forest Plans at the forest level.

Land use plan decision: Establishes desired outcomes and actions needed to achieve them. Decisions are reached using the planning process in 43 CFR 1600. When they are presented to the public as proposed decisions, they can be protested to the BLM Director. They are not appealable to IBLA.

Leasable minerals: Minerals such as coal, oil shale, oil and gas, phosphate, potash, sodium, geothermal resources, and all other minerals that may be acquired under the Mineral Leasing Act of 1920, as amended.

Locatable minerals: A mineral subject to location under the 1872 mining laws. Examples of such minerals would be gold, silver, copper, and lead as compared to oil and natural gas, which are leasable minerals.

Magnuson-Stevens Fishery Conservation and Management Act: This Act governs the conservation and management of ocean fishing. It establishes exclusive US management authority over all fishing within the exclusive economic zone, all anadromous fish throughout their migratory range (except when in a foreign nation's waters), and all fish on the Continental Shelf. The Act also establishes eight Regional Fishery Management Councils responsible for the preparation of fishery management plans to achieve the optimum yield from US fisheries in their regions. Congress amended the Act extensively when it passed the Sustainable Fisheries Act in 1996, which also changed the name of the Act from The Magnuson Fishery Conservation Management Act to the Magnuson-Stevens Fishery Conservation and Management Act.

Management decision: A decision made by the BLM to manage public lands. Management decisions include both land use plan decisions and implementation decisions.

Mineralized: The process where a substance (in this case, the buried remains of plants or animals) is converted from an organic substance to an inorganic substance, thereby becoming mineralized.

Modification: A change to the provisions of a lease stipulation, either temporarily or for the term of the lease. Depending on the specific modification, the stipulation may or may not apply to all sites within the leasehold to which the restrictive criteria are applied.

Monitoring (plan monitoring): The process of tracking the implementation of land use plan decisions.

Multi-jurisdictional planning: Collaborative planning in which the purpose is to address land use planning issues for an area, such as an entire watershed or other landscape unit, in which there is a mix of public and/or private land ownership and adjoining or overlapping tribal, State, local government, or other Federal agency authorities.

National Environmental Policy Act (NEPA) of 1969: A law enacted on January 1, 1970 that established a national policy to maintain conditions under which man and nature can exist in productive harmony and fulfill the social, economic, and other requirements of present and future generations of Americans. It established the Council on Environmental Quality for coordinating environmental matters at the federal level and to serve as the advisor to the President on such matters. The law made all federal actions and proposals that could have significant impact on the environment subject to review by federal, state, and local environmental authorities.

Native (indigenous) species: A species of plant or animal that naturally occurs in an area and that was not introduced by humans.

National Forest System (NFS) lands: Forests and grasslands that the Forest Service (FS) manages. Includes both lands reserved from the federal estate and acquired lands.

National forest visit: the entry of one person upon a national forest to participate in recreation activities for an unspecified period of time.

No Surface Occupancy (NSO): A fluid minerals leasing constraint that prohibits occupancy or disturbance on all or part of the lease surface to protect special values or uses. Lessees may exploit the fluid mineral resources under the leases restricted by this constraint through use of directional drilling from sites outside the NSO area.

Objective: A description of a desired condition for a resource. Objectives can be quantified and measured and, where possible, have established time frames for achievement.

Open: Generally denotes that an area is available for a particular use or uses. Refer to specific program definitions found in law, regulations, or policy guidance for application to individual programs. For example, 43 CFR 8340.0-5 defines the specific meaning of “open” as it relates to OHV use.

Orogeny: The process of forming mountains

Petroglyph: A form of rock art created by incising, scratching or pecking designs into rock surfaces.

Pictograph: A form of rock art created by applying mineral based or organic paint to rock surfaces.

Paleobiogeography: The study of the geographic distribution of ancient biodiversity.

Paleoecology: The study of the interactions between fossil organisms and their environments, including their life cycle, their interactions, their natural environment, their manner of death and burial. Paleoecology’s aim is to build the most detailed model possible of the life environment of those organisms we find today as fossils.

Paleoenvironments: Ancient environments.

Permitted use: The forage allocated by, or under the guidance of, an applicable land use plan for livestock grazing in an allotment under a permit or lease; expressed in Animal Unit Months (AUMs) (43 CFR 4100.0-5).

Permittee: A person or company permitted to graze livestock on public land.

Phanerozoic: The period of geologic time that is the most recent eon; defined to include all of geologic history characterized by conspicuous animal life. Includes the Paleozoic, Mesozoic, and Cenozoic, and extends from the present to 600 million years ago.

Phylum (*Plural*, Phyla): A taxonomic rank at the level below kingdom and above class.

Physiography: terrain texture, rock types, and geologic structure and history

Planning area: Geothermal potential area; includes all lands regardless of ownership or administration.

Planning analysis: A process using appropriate resource data and NEPA analysis to provide a basis for decisions in areas not yet covered by an RMP.

Planning criteria: The standards, rules, and other factors developed by managers and interdisciplinary teams for their use in forming judgments about decision making, analysis, and data collection during planning. Planning criteria streamlines and simplifies the resource management planning actions.

Prehistoric resources: refer to any material remains, structures, and items used or modified by people before Euro-Americans established a presence in the region.

Project area: Lands within the 12 western states, including Alaska; includes all lands regardless of ownership or administration.

Public lands: Surface acres managed by the Bureau of Land Management (BLM). Includes both lands reserved from the federal estate and acquired lands.

Regression: Fall of sea level relative to the shore with the resulting movement of the sea off the land.

Renewable energy: Resources that constantly renew themselves or that are regarded as practically inexhaustible. These include solar, wind, geothermal, hydro and wood. Although particular geothermal formations can be depleted, the natural heat in the Earth is a virtually inexhaustible reserve of potential energy. Renewable resources also include some experimental or less-developed sources such as tidal power, sea currents and ocean thermal gradients.

Research and Natural Area (RNA): Research Natural Areas (RNAs) are areas that contain important ecological and scientific values and are managed for minimum human disturbance. RNAs are primarily used for non-manipulative research and baseline data gathering on relatively unaltered community types. Since natural processes are allowed to dominate, RNAs also make excellent controls for similar communities that are being actively managed. In addition, RNAs provide an essential network of diverse habitat types that will be preserved in their natural state for future generations.

Resource Advisory Council (RAC): A council established by the Secretary of the Interior to provide advice or recommendations to BLM management. In some states, Provincial Advisory Councils (PACs) are functional equivalents of RACs.

Resource Management Plan (RMP): The BLM considers resource management plans to be synonymous with land use plans so the terms may be used interchangeably. Land use plan decisions made in RMPs establish goals and objectives for resource management (such as desired future conditions), the measures needed to achieve these goals and objectives, and parameters for using public lands. Land use planning decisions are usually made on broad scale and customarily guide subsequent site-specific implementation decisions.

Resource use level: the level of use allowed within an area. It is based on the desired outcomes and land use allocations in the land use plan. Targets or goals for resource use levels are established on an area-wide or broad watershed level in the land use plan. Site-specific resource use levels are normally determined at the implementation level, based on site-specific resource conditions and needs as determined through resource monitoring and assessments.

Revision: The process of completely rewriting the land use plan due to changes in the planning area affecting major portions of the plan or the entire plan.

Right-of-Way (ROW): An easement or permit, which authorizes public land to be used for a specified purpose that generally requires a long narrow strip of land. Examples are roads, power-lines, pipelines, etc.

Seismic exploration: Seismic exploration remains the most common way to locate sub-surface resources. The process involves sending sound waves into the earth at one point and recording them at others after having passed through differing geological strata. There are two common methods utilized today. One method involves the detonation of small explosive charges. The other method consists of a truck that drops a huge weight at various intervals. The data collected is used to show probable sub-surface resource deposits.

Site visit: The entry of one person upon a national forest site or area to participate in recreation activities for an unspecified period of time.

Sole source aquifer: Defined by the US EPA as an aquifer supplying at least 50 percent of the drinking water consumed in the area overlying the aquifer, where the surrounding area has no alternative drinking water source(s) that could physically, legally, and economically supply all those who depend upon the aquifer for drinking water.

Special status species: Includes proposed species, listed species, and candidate species under the ESA; State-listed species; and BLM State Director-designated sensitive species (see BLM Manual 6840 - Special Status Species Policy).

Speciation: The process leading to the creation of new species. It is one form of biological evolution. Speciation occurs when a parent species splits into two (or more) reproductively-isolated populations, each of which then accumulates changes from sexual reproduction and/or random mutation until the populations are no longer capable of interbreeding.

Standard lease terms and conditions: Areas may be open to leasing with no specific management decisions defined in a Resource Management Plan; however, these areas are subject to lease terms and conditions as defined on the lease form (Form 3100-11, Offer to Lease and Lease for Oil and Gas; and Form 3200-24, Offer to Lease and Lease for Geothermal Resources).

State Implementation Plan (SIP): A strategic document, prepared by a State (or other authorized air quality regulatory agency) and approved by the U.S. Environmental Protection Agency, which thoroughly describes how requirements of the Clean Air Act will be implemented (including standards to be achieved, control measures to be applied, enforcement actions in case of violation, etc.).

Stipulation: A condition of lease issuance that provides protection for other resource values or land uses by establishing authority for substantial delay or site changes or the denial of operations within the terms of the lease contract.

Stipulation Standards: the physical and temporal conditions, resources or resource values that must be present and met for application of a specific stipulation to a specific lease

Strategic Plan (BLM Strategic Plan): A plan that establishes the overall direction for the BLM. This plan is guided by the requirements of the Government Performance and Results Act of 1993, covers a 5-year period, and is updated every 3 years. It is consistent with FLPMA and other laws affecting the public lands.

Stromatolite: Stromatolites are commonly thought to have been formed by the trapping, binding, and cementation of sedimentary grains by microorganisms, especially blue-green algae (cyanobacteria).

Subduction: Relates to plate tectonics in which the margin of one plate is subducted (descends) below an adjacent plate.

Subsidence: The lowering of the soil level caused by the shrinkage of organic layers.

Surficial: Pertaining to or lying in or on the surface. Sediments covering bedrock.

Taphonomy: The study of what happens to an organism's remains from the time of death until discovery by a paleontologist in an attempt to better interpret the fossil record and conditions responsible for fossil preservation. It includes processes such as scavenging, weathering, transport, and diagenesis.

Temporal: Refers to geologic time for the purposes of this report.

Tectonic: Tectonics is a field of study within geology concerned generally with the structure of the crust of the Earth and particularly with the forces and movements that have operated in a region to create geomorphic features.

Terranes: A crustal block or fragment that preserves a distinctive geologic history that is different from the surrounding areas and that is usually bounded by faults

Timing Limitation (TL): This stipulation limits activity during a specified period of the year. A TL stipulation is intended for application where standard lease terms are deemed insufficient to achieve the level of resource protection necessary to protect the public interest, but where an NSO is deemed overly restrictive. The scope of the TL stipulation goes beyond ground-disturbing activities to encompass any source of protracted or high-intensity disturbance that could interfere with normal wildlife behavior and adversely affect habitat use. The limitation is applied annually for a specified period lasting more than 60 days. Under the Proposed Plan, TLs may also be applied to land uses and activities other than oil and gas development.

Transmission: The movement or transfer of electric energy over an interconnected group of lines and associated equipment between points of supply and points at which it is transformed for delivery to consumers, or is delivered to other electric systems. Transmission is considered to end when the energy is transformed for distribution to the consumer.

Threatened species: 1) Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range, and 2) as further defined by the Endangered Species Act of 1973.

Transgression: Rise of sea level relative to the shore with resulting encroachment of the sea onto the land.

Tribal interests: Native American or Native Alaskan economic rights such as Indian trust assets, resource uses and access guaranteed by treaty rights, and subsistence uses.

Traditional cultural resources or properties: Areas of cultural importance to contemporary communities, such as sacred sites or resource gathering areas.

Utility: A regulated entity which exhibits the characteristics of a natural monopoly. For the purposes of electric industry restructuring, "utility" refers to the regulated, vertically-integrated electric company. "Transmission utility" refers to the regulated owner/operator of the transmission system only. "Distribution utility" refers to the regulated owner/operator of the distribution system which serves retail customers.

Vapor-dominated: A geothermal reservoir system in which subsurface pressures are controlled by vapor rather than by liquid. Sometimes referred to as a dry-steam reservoir.

Visual resource protection program: A program to establish the criteria and methodologies to manage visual resource protection measures throughout the life of a project (from design, construction, and operation of the project through reclamation).

Vertebrate: Animals with vertebrae (back bones), including fish, amphibians, reptiles, birds and mammals.

Waiver: A permanent exemption from a lease stipulation. The stipulation no longer applies anywhere within the leasehold.

Watt: The electrical unit of power. The rate of energy transfer equivalent to 1 ampere flowing under a pressure of 1 volt at unity power factor.

Watt-hour (Wh): An electrical energy unit of measure equal to 1 watt of power supplied to, or taken from, an electric circuit steadily for 1 hour.

Wilderness area: An area of public land designated by an Act of Congress to be protected in its natural condition according to the requirements of the Wilderness Act of 1964.

Wilderness characteristics: Identified by congress in the 1964 wilderness act; namely size, naturalness, outstanding opportunities for solitude or a primitive and unconfined type of recreation, and supplemental values such as geological, archeological, historical, ecological, scenic, or other features. It is required that the area possess at least 5,000 acres or more of contiguous or be of a size to make practical its preservation and use in an unimpaired condition; be substantially natural or generally appear to have been primarily by the forces of nature, with the imprint of man being substantially unnoticeable; and have either outstanding opportunities for solitude or a primitive and unconfined type of recreation.

Wilderness inventory areas : These areas are found in Utah that were not made into WSAs but citizens inventoried and found wilderness characteristics. During the Clinton Administration, the BLM re-inventoried these lands, completed in 1999, and found Wilderness characteristics on these lands.

Wilderness Study Area (WSA): Created by the BLM through the inventory process of the Federal Land Policy and Management Act (FLPMA), which required the BLM to inventory lands under its management authority for wilderness quality and protect those lands until Congress decides whether or not to designate the land as Wilderness.

FES 08-44

FINAL

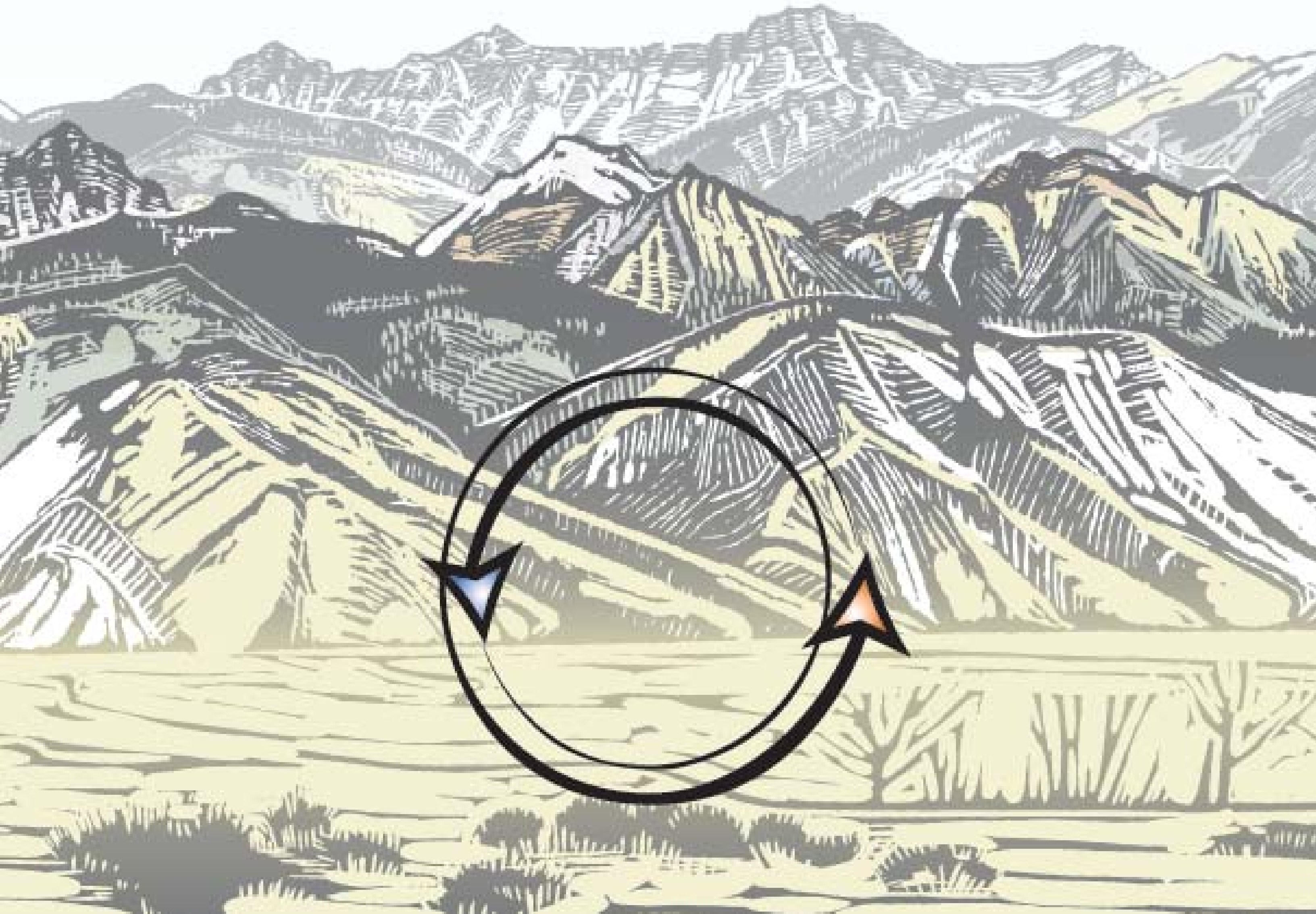
Programmatic Environmental Impact Statement for

Geothermal Leasing

in the Western United States

Volume II: Analysis for Pending Lease Applications

October 2008



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GEOTHERMAL LEASING IN THE WESTERN UNITED STATES

VOLUME II: ANALYSIS FOR PENDING LEASE APPLICATIONS

OCTOBER 2008

US DEPARTMENT OF THE INTERIOR

BUREAU OF LAND MANAGEMENT

US DEPARTMENT OF AGRICULTURE

UNITED STATES FOREST SERVICE

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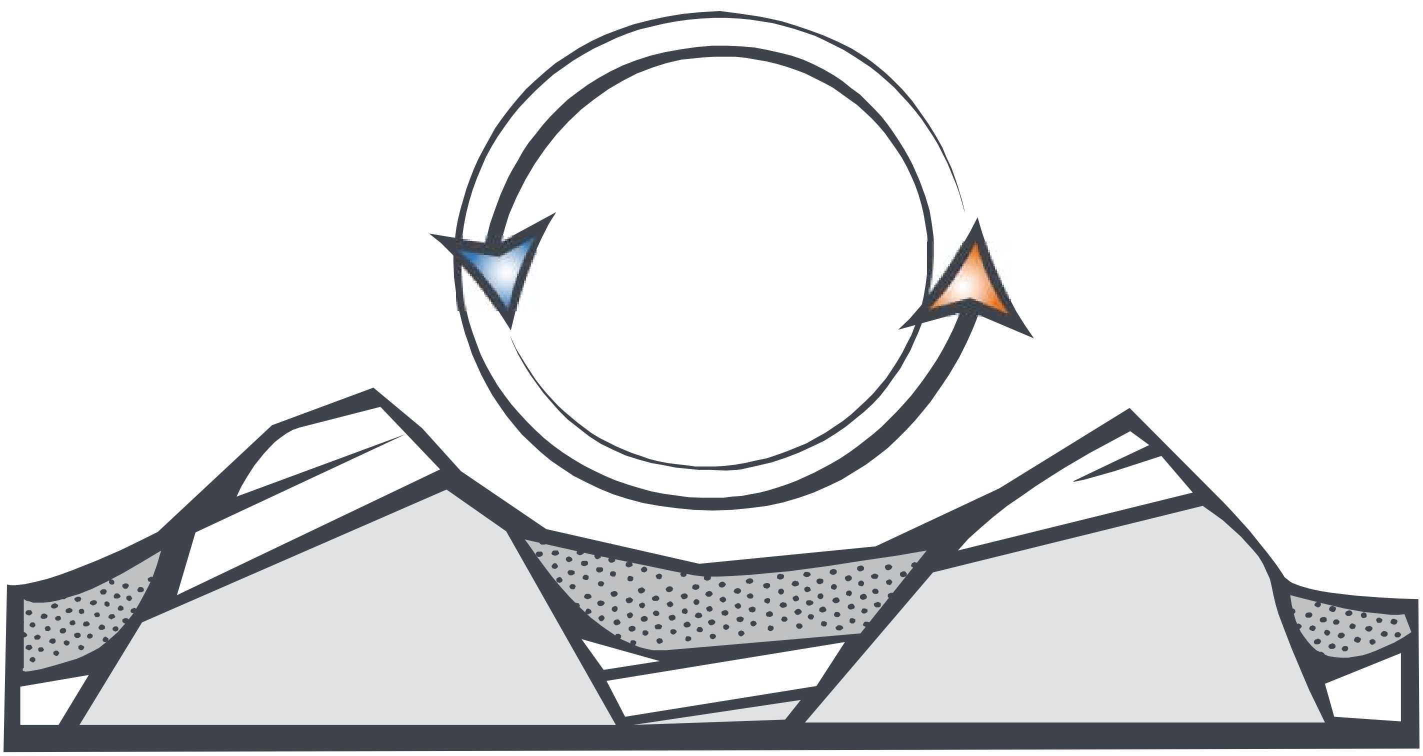

Chapter 10

Introduction to Pending Lease Analysis

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SECTION 10
INTRODUCTION TO PENDING LEASE ANALYSIS

10.1 BACKGROUND

The Energy Policy Act of 2005 requires that the Secretary of the Interior and the Secretary of Agriculture enter into a Memorandum of Understanding (see Appendix B) regarding coordination of leasing and permitting for geothermal development of public lands and National Forest System lands under their respective jurisdictions and further:

> "that the Memorandum of Understanding shall establish a program reducing the backlog of geothermal lease applications pending on January 1, 2005, by 90 percent within the 5-year period beginning on the date of enactment of this Act, including, as necessary, by issuing leases, rejecting lease applications for failure to comply with the provisions of the regulations under which they were filed, or determining that an original applicant (or the applicant's assigns, heirs, or estate) is no longer interested in pursuing the lease application."

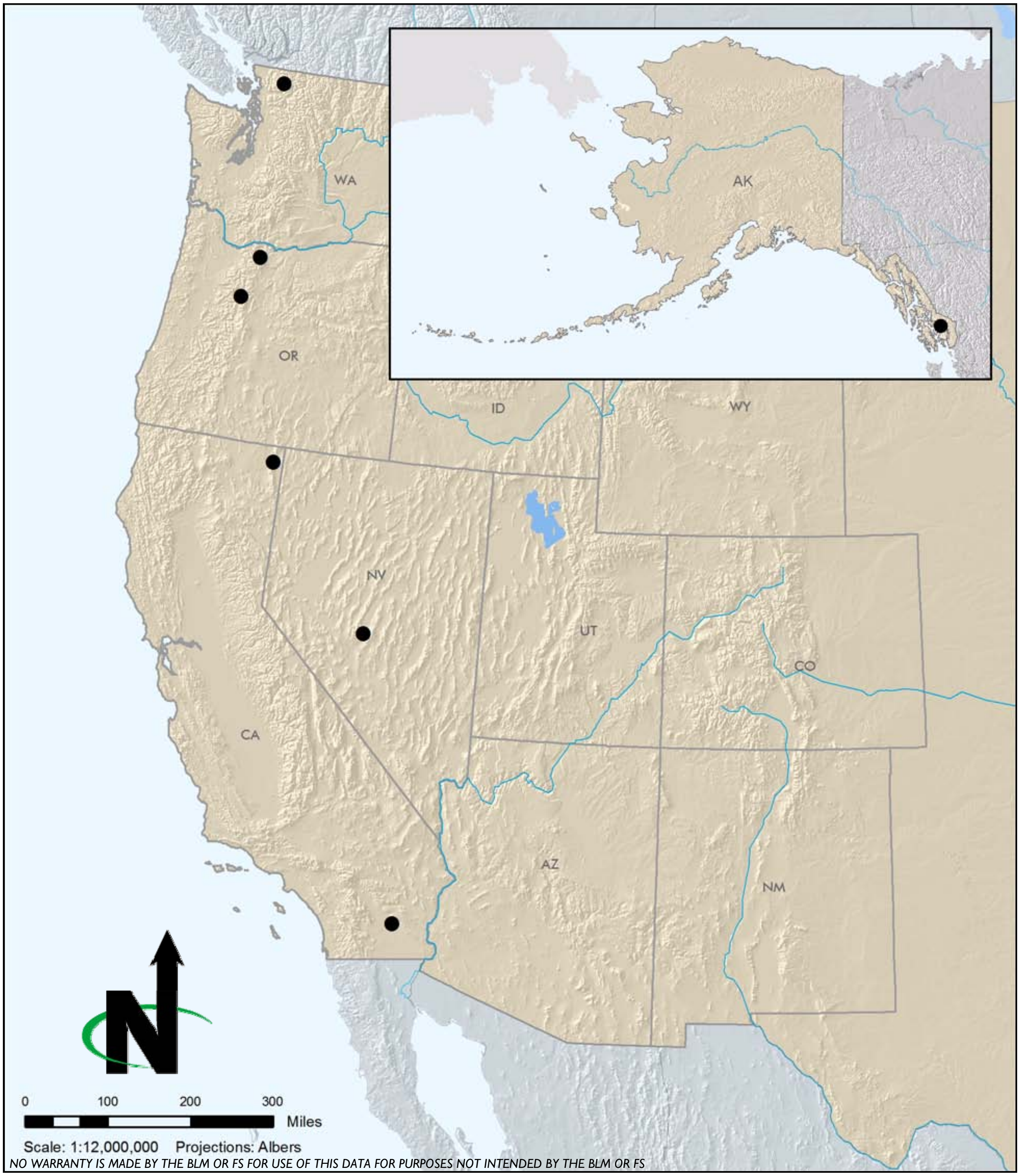
Volume II of the PEIS provides lease-specific analysis to decision-makers to aid them in making decisions on whether to issue or deny 19 geothermal lease applications that were pending as of January 1, 2005. The 19 pending lease applications are collocated in seven distinct geographic groups across the Western US and Alaska, as shown in Table 10-1 and Figure 10-1. Each of these locations is analyzed in its own section of this volume.

10.2 STATUS OF PENDING LEASE APPLICATIONS

As of January 1, 2005, there were 194 pending lease applications; 130 on BLM public lands and 64 on NFS lands. Since January 1, 2005 the BLM and FS have processed or resolved many of the lease applications. In June of 2007 there were 55 remaining pending leases. In order to identify pending lease applications that still require a decision, the following steps were taken:

Table 10-1
Pending Lease Applications (Prior to January 1, 2005)

Group	State	BLM or FS Office	Serial Number	Acres	Township	Range	Section(s)
1	AK	Tongass NF	AKAA 084543	2560	068S 068S	089E 090E	36 29-31
1	AK	Tongass NF	AKAA 084544	2560	068S	090E	15, 21, 22, 28
1	AK	Tongass NF	AKAA 084545	2560	068S 068S	090E 091E	12-14 7
2	CA	El Centro FO	CACA 046142	2161	090S	120E	02, 12, 14, 24
2	CA	El Centro FO	CACA 043965	1160	100S	140E	8, 22, 28
3	CA	Modoc NF	CACA 042989	480	440N	150E	14
3	CA	Modoc NF	CACA 043744	2560	440N	150E	10, 15, 22, 27
3	CA	Modoc NF	CACA 043745	2560	440N	150E	9, 16, 21, 28
4	NV	Battle Mtn FO and Toiyabe NF	NVN 074289	440	110N	430E	18
5	OR	Mount Hood NF	OROR 017049	1538	010S 020S	090E 090E	36 1, 2
5	OR	Mount Hood NF	OROR 017051	2480	010S	100E	25-28
5	OR	Mount Hood NF	OROR 017052	2480	010S	100E	32-35
5	OR	Mount Hood NF	OROR 017053	1376	010S 020S	100E 100E	36 6, 7
5	OR	Mount Hood NF	OROR 017327	1294	020S 020S	090E 100E	36 5, 8
6	OR	Willamette NF	OROR 054587	1115	0100S 0110S	070E 070E	29 2, 3
7	WA	Mt Baker NF	WAOR 056025	2403	0380N 0380N	080E 090E	36 19, 30-31
7	WA	Mt Baker NF	WAOR 056027	2560	0370N	80E	11, 13, 14, 24
7	WA	Mt Baker NF	WAOR 056028	2544	0370N	80E	10, 15, 22, 23
7	WA	Mt Baker NF	WAOR 056029	1941	0370N	80E	16, 17, 20, 21



C://EMPSi/GeothermalPEIS/Figures

There are 19 pending noncompetitive lease application sites in seven different geographic areas evaluated in Volume II of the PEIS.

<u>LEGEND:</u>

● Pending lease application site

Evaluated Pending Lease Site Areas in the 11 Western States and Alaska

Figure 10-1

- Pending lease applications were identified in BLM's database, LR2000, by BLM staff and a master list was generated.
- This list was sorted to eliminate lease applications submitted after January 1, 2005.
- Recently completed and ongoing NEPA documents that analyzed pending lease applications were identified. For those in which a decision was made or was actively being pursued, the leases were considered in process and eliminated.
- Contacted lease applicants to ensure they still were interested in pursuing the lease application.

The resulting list was circulated to BLM and FS staff for their review. A total of 34 lease applications were identified as still pending. Of these 15 are being actively addressed as shown in Table 10-2. The remaining 19 lease applications, grouped together in seven geographic clusters (Figure 10-1 and Table 10-1), were identified for supplemental environmental analysis. Those analyses are presented in this Volume.

Table 10-2
Status of Remaining Pending Lease Applications (prior to January 1, 2005)

Serial Number(s)	BLM Office	Status
CACA 042841, 042844	Bishop	Environmental review complete; decision pending.
CACA 046141	El Centro	Within habitat for the flat tail horned lizard (a sensitive species). Management plan limits development in the habitat. BLM reviewing cumulative effects of development in the habitat.
CACA 042993, 042994, 042995	El Centro	An EIS is being prepared. The US Navy is the lead agency and BLM is cooperating agency. Notice of Intent published on May 5, 2008.
CACA 042750, 042751, 042752	El Centro	Analyzed in the Truckhaven EIS; Record of Decision pending.
CACA 043993, 043998, 044082	Ridgecrest	Undergoing a separate environmental review process.
IDI 034353	Idaho Falls	Environmental review complete; decision pending.
NMNM 108801	Las Cruces	Environmental review is underway; decision pending.
NVN 075468	Winnemucca	At BLM State Office for adjunction. On land administered by Bureau of Reclamation and proposed for transfer to Pershing County. The Winnemucca Leasing EA (2002) covers the lease area.

CHAPTER 11

TONGASS NATIONAL FOREST

ANCHORAGE DISTRICT

ANALYSIS FOR PENDING LEASE APPLICATIONS:

AK 084543, AK 084544, AK 084545

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SECTION 11.1 INTRODUCTION

11.1.1 INTRODUCTION

This analysis describes the environmental effects of leasing approximately 7,680 acres of NFS land within the Ketchikan-Misty Fiords Ranger District of the Tongass NF, within the BLM Anchorage District to private industry for the development of geothermal resources.

The pending lease sites are within the Tongass NF, which is the surface management agency for the lease sites. Subsurface mineral rights (including leasable minerals such as geothermal) are managed by the BLM Alaska State Office, which issues leases with the consent of the FS (here, the Ketchikan-Misty Fiords Ranger District of the Tongass NF) for the lands under application in the Tongass NF.

This lease-specific analysis serves as an information resource to aid decision-makers in determining whether these lands are appropriate for leasing under FS and BLM management policies and existing environmental regulations.

11.1.2 LOCAL REGULATORY CONSIDERATIONS

The pending lease application sites are located within Ketchikan Gateway Borough, Alaska and are subject to state and local regulations, as described below.

Tongass National Forest Land and Resources Management Plan (2008)

The Tongass National Forest Land and Resources Management Plan (Forest Plan) guides all natural resource management activities and establishes management standards and guidelines for the Tongass National Forest. It describes resource management practices, levels of resource production and management, and the availability and suitability of lands for resource management.

The Forest Plan identifies the following resource management goals that apply to geothermal leasing:

- Minerals and Energy – Provide for environmentally sound mineral exploration, development, and reclamation in areas open to mineral entry and in areas with valid existing rights that are otherwise closed to mineral entry. Seek withdrawal of specific locations where mineral development may not meet Land Use Designation objectives.
- Economic – Provide for environmentally sound mineral exploration, development, and reclamation in areas open to mineral entry and in areas with valid existing rights that are otherwise closed to mineral entry. Seek withdrawal of specific locations where mineral development may not meet Land Use Designation objectives.
- Wildlife, Fish, and Plants – Maintain healthy forest ecosystems; maintain a mix of habitats at different spatial scales (i.e., site, watershed, island, province and forest) capable of supporting the full range of naturally occurring flora, fauna, and ecological processes native to Southeast Alaska.

The Forest Plan identifies the following forest-wide standards and guidelines that apply to geothermal activity:

- Encourage the exploration, development, and extraction of locatable and leasable minerals and energy resources.
- A Notice of Intent and/or a plan of operations is required for locatable, leasable, and salable minerals (Consult FSM 2810, 2820, 2850, and 36 CFR 228).
- A plan of operations will receive prompt evaluation and action within the time frames established in 36 CFR 228.
- Conduct an environmental analysis with appropriate documentation for all operating plans.
- Work with claimants to develop a plan of operations that adequately mitigates adverse impacts on Land Use Designation objectives. Include mitigation measures for locatable and salable minerals and standard and special stipulations in leasing actions that are compatible with the scale of proposed development and commensurate with potential resource impacts.
    1. Maintain the habitats, to the maximum extent feasible, of anadromous fish and other foodfish, and maintain the present and continued productivity of such habitats when such habitats are affected by mining activities. Assess the effects on

populations of such fish in consultation with appropriate state agencies (Consult ANILCA, Section 505(a)).

2. Apply appropriate Transportation Forest-wide Standards & Guidelines to the location and construction of mining roads and facilities.
3. Reclaim disturbed areas in accordance with an approved plan of operations.
4. Apply best management practices to maintain water quality for the beneficial uses of water (Consult Appendix C of the Tongass Forest Plan and FSH 2509.22).
5. Periodically inspect minerals activities to determine if the operator is complying with the regulations of 36 CFR 228 and the approved plan of operations.

- A bond may be required for locatable, leasable, and salable mineral operations to ensure operator performance and site reclamation are completed.
- Permit mineral material sites only after an environmental analysis assures other resources are adequately protected, the site location and operating plan are consistent with the Land Use Designation emphasis, and such resources are not reasonably available on private land. Require bonds and reclamation as appropriate (Consult FSM 2850 and 36 CFR 228).
- Where the opportunity exists, design, excavate, and reclaim material sites to facilitate their use for dispersed recreation or other desirable uses such as conversion to salmonid rearing ponds and spawning channels.

Ring of Fire Resource Management Plan (2008)

The pending lease sites are on NFS land; however, subsurface mineral rights are managed by the BLM. The lease area is within the BLM Anchorage District, which is managed by the Ring of Fire Resource Management Plan. The vision of the Ring of Fire Resource Management Plan is to provide the basis for developing future site-specific implementation planning on 1.3 million acres of public land and the underlying subsurface estate of that land, as well as certain BLM-managed subsurface estate underlying areas in non-federal ownership, or administered by other federal agencies. There are several basic principles supporting this vision:

- Natural resources can be managed to provide for human use and a healthy environment;
- Resource management must be focused on ecological principles to reduce the need for single resource or single species management;

- Stewardship, the involvement of people working with natural processes, is essential for successful implementation;
- The BLM cannot achieve this vision alone but can, by its management processes and through cooperation with others, be a significant contributor to its achievement; and
- A carefully designed program of monitoring, research and adaptation will be the change mechanism for achieving this vision.

The Leasable Minerals section of the Ring of Fire Resource Management Plan states the following objectives:

- Maintain of enhance opportunity for mineral exploration and development while maintaining other resource values.
- Public lands and the Federal mineral estate will be made available for orderly and efficient exploration, development, and production unless withdrawal or other administrative action is justified in the national interest.
- In addition to oil and gas, geothermal resources would be available for leasing in areas open to oil and gas leasing.

The Resource Management Plan includes the following Management Actions/Direction regarding leasable minerals:

- Segregation of lands currently under selection by the State and Native corporations from mineral leasing to avoid potential encumbrances prior to conveyance. Decisions made within the Ring of Fire Resource Management Plan/Environmental Impact Statement to “open” areas for mineral exploration or development would not go into effect unless lands are retained long-term in federal ownership;
- All areas open to mineral leasing would be open to geophysical exploration, except those lands containing No Surface Occupancy (NSO) restrictions, which would only be available for geophysical exploration in winter conditions, and would be subject to stipulations and through Casual Use as described under 43 CFR 3150.05(b) during non-winter conditions.
- Geothermal resources would be available for leasing in areas open to oil and gas leasing. Areas closed to oil and gas leasing would also be closed to geothermal leasing.
- All leases will be subject to Required Operating Procedures, Stipulations, and Standard Lease Terms as described in Appendix D of the Ring of Fire Resource Management Plan.

11.1.3 Scope of Analysis and Approach

This lease-specific analysis incorporates by reference the programmatic analysis presented in Volume I. This analysis examines the cluster of three pending lease application sites, describes the Reasonably Foreseeable Development scenario for this cluster, examines the existing environmental setting, and describes the potential direct, indirect, and cumulative impacts that lease issuance and anticipated actions following lease issuance at these sites would have on the human and natural environment.

This report focuses on specific key resource concerns in the lease area, and incorporates by reference the impacts described in the PEIS. Decision makers should consider both the impacts described in this lease-specific analysis, in addition to those described in the main body of the PEIS. The analysis presented here does not reiterate the details of impacts identified in the PEIS, but rather refers to them as they arise in the impact analysis for pending lease application sites addressed here. Tongass NF staff members were contacted during the preparation of this analysis to help identify local resource concerns.

11.1.4 Cumulative Actions

One identified cumulative project has been identified within the Bell Island area.

Swan Lake to Tyee Lake Electrical Intertie

The Swan Lake to Tyee Lake Intertie, the first leg of the larger Southeast Alaska power grid, is under construction and will pass through Bell Island. The intertie is projected to reduce the dependence on diesel fuel, reducing air emissions and the risk of fuel spills. The reliable energy that the intertie will bring is expected to attract new economic opportunities to the communities of Southeast Alaska. As of April 2008, trees have been felled on Bell Island for the intertie right-of-way and the merchantable sawlog volume has been removed. The transmission line is projected to be complete and operational by autumn 2009 (Kolund 2008; US Forest Service 2008a).

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SECTION 11.2
PROPOSED ACTION AND ALTERNATIVES

11.2.1 INTRODUCTION

This chapter provides the details of the proposed action, alternatives to the proposed action, and an overview of the reasonably foreseeable develop (Reasonably Foreseeable Development) scenario for pending lease application sites AK 084543, 084544, and 084545.

11.2.2 PROPOSED ACTION

The proposed action is for the FS to provide a consent determination to the BLM to issue the three leases in the Tongass NF and for the BLM to issue the leases to the geothermal lease applicant. The 7,680 acres of land are spread across nine miles, encompassing most of Bell Island as well as a portion of the adjacent mainland. Bell Island is located near the southeastern end of the Alaskan Panhandle, approximately 43 miles north of Ketchikan (see Figure 1). Lease boundaries could be adjusted in the decision to avoid unacceptable impacts on sensitive resources.

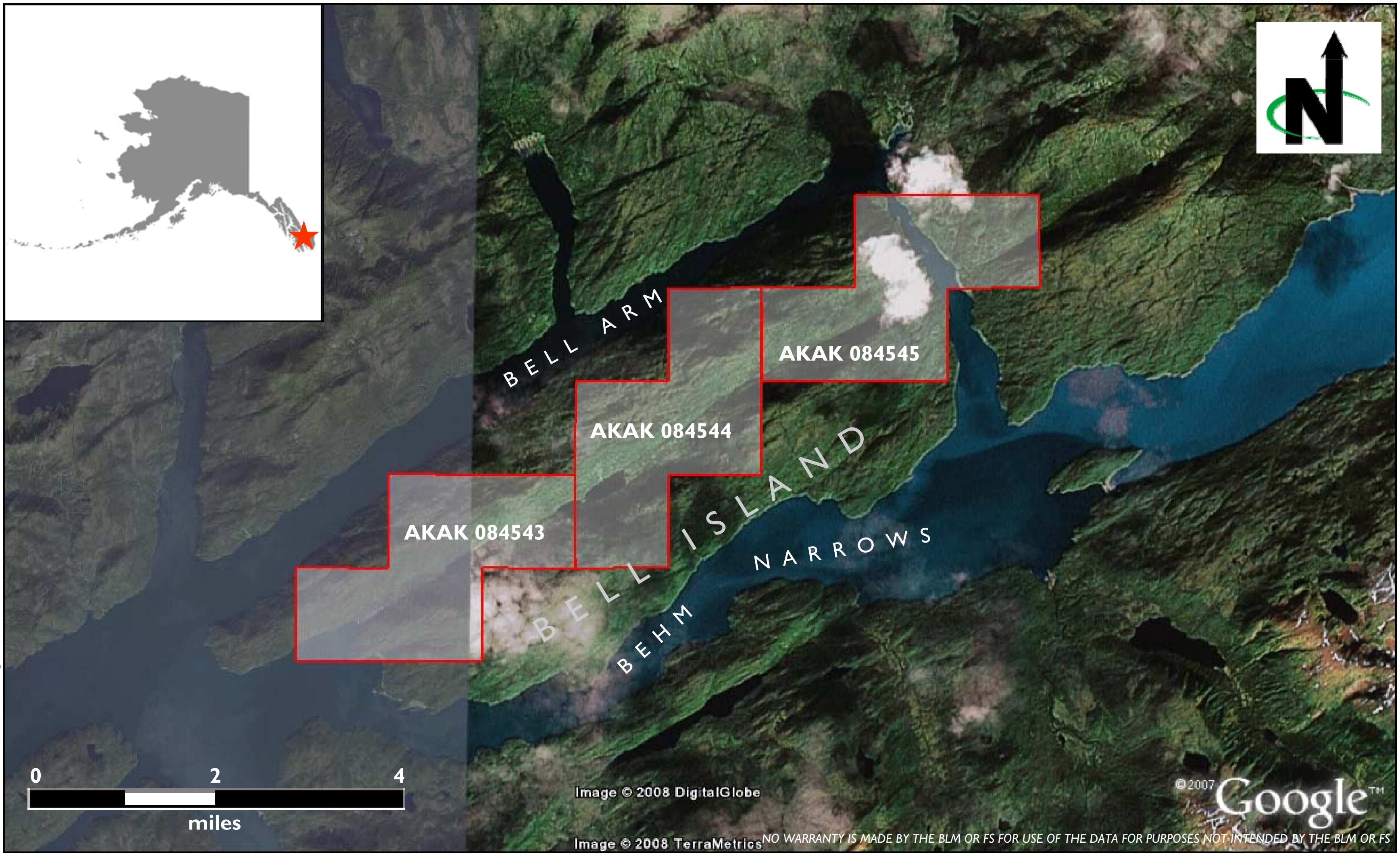
Lease AK 084543

AK 084543 includes approximately 2,560 acres, comprised of four contiguous sections, as follows:

- T68S R89E S36
- T68S 90E S31, S30, S29

Section 36 comprised of approximately two thirds land (Bell Island) and one third ocean waters. The section contains the lower portion of Bell Island Hot Springs, a Seaplane Ramp, and ranges in elevation from sea level to 1,500 feet.

Section 31 is comprised largely of Bell Island, with the upper portion of Bell Island Hot Springs, a creek that flows by and collects water from the hot springs, a portion of a lake higher up that feeds that creek, and a separate creek



C://EMPSi/GeothermalPEIS/Figures

All three sites are on NFS land.

LEGEND:
Lease site boundary

Tongass Lease Locations
AKAK 084543, 084544, 084545
Tongass NF / Anchorage District

Figure 11-1

on the southwestern portion of the section. The lake mentioned here is one of a series of connected Bell Island Lakes, and is at an elevation of approximately 200 feet above mean sea level. Section 31 ranges in elevation from sea level at the southwest corner of the section, to nearly 1,900 feet above mean sea level at the central-eastern edge of the section.

Section 30 is comprised largely of Bell Island, with the northwest corner being marine waters, and the southeastern corner being the aforementioned lake. Elevation ranges from sea level to 1,600 feet. There are no developed uses in this section.

Section 29 contains no developed uses. It contains portions of the lower two Bell Island Lakes, and ranges in elevation from 200 feet above mean sea level at the lakeshore of the lower lake, to 1,900 feet at the southeastern corner. A creek connects the two lakes.

Lease AK 084544

AK 084544 includes approximately 2,560 acres, comprised of the following four contiguous sections: T68S 90E S15, S21, S22, and S28.

Section 15 is comprised largely of land (Bell Island) with a small portion of marine waters (Bell Arm) in the northeast corner, two isolated bodies of water in the northeast quarter section, and a small lake in the southeast quarter section that drains to the other Bell Island Lakes. The section ranges from sea level to 2,235 feet above mean sea level at a peak in the southwest quarter section. The isolated water bodies are at elevations of 1,300 and 1,600 feet. The water body that is connected to the Bell Island Lakes is at an elevation of 1,100 feet. There are no developed uses in this section.

Section 21 is comprised largely of land, with a series of surface freshwater bodies that include several isolated ponds, a portion of one of the Bell Island Lakes, and two creeks that run into that lake. The elevation of Section 21 ranges from 300 feet above mean sea level at one of the Bell Island Lakes in the southern portion of the section, to 1,400 feet above mean sea level in the central portion of the section. There are no developed uses in this section.

Section 22 is comprised largely of land (Bell Island) with two isolated water bodies at elevations of 1,200 feet and 1,600 feet, and two creeks. The section ranges from 500 feet above mean sea level at the southwestern edge, to 2,200 feet along the northeastern edge. There are no developed uses in this section.

Section 28 is comprised largely of land (Bell Island) with surface water bodies being limited to portions of two of the Bell Island Lakes and a creek that connects them. Elevations range from 300 feet above mean sea level at one of the Bell Island Lakes in the northeastern portion of the section, to 2,067 feet at a peak in the southwest quarter section. There are no developed uses in this section.

Lease AK 084545

AK 084544 includes approximately 2,560 acres, comprised of the following four contiguous sections:

- T68S 90E S12, S13, S14
- T68S 91E S7

Section 12 is comprised of approximately 75 percent land, most of which is Bell Island and a small portion of which is mainland in the northeast quarter section, and 25 percent marine waters, Anchor Pass, separating Bell Island from the mainland. There are no other surface water bodies within this section. The section ranges from sea level to 2,200 feet above mean sea level on Bell Island, and 1,800 feet on the mainland. There are no developed uses in this section.

Section 13 is comprised almost completely of land (Bell Island), with only the extreme northeast corner including a portion of the waters of Anchor Pass. The only other surface water body on the section is a creek that traverses the northeast quarter section. The elevation of Section 13 ranges in elevation from sea level to 2,200 feet at the southwestern corner. There are no developed uses in this section.

Section 14 is comprised entirely of land (Bell Island) with one isolated pond at an elevation of 1,300 feet, two creeks flowing out of the section to the east and to the west, and a small body of water that forms the upper portion of the Bell Island Lakes. The latter water body is located on the southwestern corner of Section 14 and is partially fed by the western creek. The section ranges from 1,100 feet above mean sea level to 2,521 feet at a peak in the central northern portion of the section. There are no developed uses in this section.

Section 7 is comprised largely of land (Alaska mainland) with the southwestern half of the southwestern quarter section containing waters of Anchor Arm. The only other surface water body is a creek that enters the section on the eastern side and empties into Anchor Arm in the southwestern quarter section. Elevations range from sea level to 1,800 feet above mean sea level in the northeastern corner of the section. There are no developed uses in this section.

11.2.3 Alternatives

Two alternatives are considered in this lease-specific analysis: Alternative A, the No Action alternative, and Alternative B, Leasing with Stipulations.

Alternative A: No Action

Under Alternative A, the FS would not issue a consent determination for any of the lease applications.

Alternative B: Leasing with Stipulations

Under Alternative B, the FS would issue a consent determination for the lease applications, and the BLM would issue the leases with the stipulations identified in Chapter 2 of the PEIS.

11.2.4 Reasonably Foreseeable Development Scenario

It is anticipated that the lease area would be developed for a single, 20 megawatt binary power plant. The power plant would provide electricity to Bell Island Hot Springs, possibly to the Yes Bay Lodge, via underwater cable, and to the Swan Lake to Tyee Lake Electrical Intertie, contributing to the electricity supply for the City of Ketchikan. Yes Bay Lodge is in Yes Bay, approximately 8.5 miles west of the lease area. The electrical intertie would cross Bell Island and is expected to be operational by autumn 2009. Bell Island Hot Springs and the Yes Bay Lodge both currently operate on gas/diesel-powered electrical generators.

Exploration activities for a 20 megawatt plant is expected to involve approximately 6 temperature gradient holes, disturbing approximately 0.15 acre each, for a total disturbance of approximately 1 acre. Disturbance would result from the types of activities described under Chapter 2 of the PEIS under *Phase One: Geothermal Resource Exploration*.

Assuming that a commercially viable resource is found within the lease area, drilling operations and development of the site would be expected to result in a further approximately three acres of land disturbance from the types of activities described in the Reasonably Foreseeable Development scenario of Chapter 2 of the PEIS under *Phase Two: Drilling Operations*.

Utilization, the third phase of a geothermal project, is expected to result in a further approximately six acres of land disturbance from the types of activities described in the Reasonably Foreseeable Development scenario of Chapter 2 of the PEIS under *Phase Three: Utilization*. The length and alignment of transmission lines are not estimated here since these factors would depend upon the positioning of any power plant and the distance to the nearest electrical tie-in, which in this case would be the Swan Lake to Tyee Lake Electrical Intertie.

Reclamation and abandonment, the fourth phase of a geothermal project, is expected to result in temporary disturbance of all originally disturbed acres, after which, the site would graded and vegetated to pre-disturbance conditions, as described in the Reasonably Foreseeable Development scenario of Chapter 2 of the PEIS under *Phase Four: Reclamation and Abandonment*. The connection to the Swan Lake to Tyee Lake Electrical Intertie would be removed, as would the underwater cable to Yes Bay Lodge, should that connection be made in the first place.

SECTION 11.3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

11.3.1 INTRODUCTION AND GEOGRAPHIC SETTING

The following resource disciplines are not addressed in this section because they are not found in the leasing areas and are not relevant to the discussion: floodplains, unique or prime farmlands, wild horses and burros, special designations, wild and scenic rivers, livestock grazing, designated wilderness, historic and scenic trails.

All the pending lease applications are in geologic units that would be expected to have a relatively low potential for containing vertebrate fossils or scientifically significant invertebrate or plant fossils; therefore, paleontological resources are not analyzed in detail. Paleontological mitigative procedures outline in the PEIS would be followed for all ground distributing activities. Protective measures outlined in the PEIS would be applied.

Future development of the proposed lease sites would also yield the same health and safety impacts as identified in Chapter 4 of Volume I of the PEIS and therefore is not repeated in this lease-specific analysis.

11.3.2 LAND USE AND RECREATION

Setting

This section is a discussion of the current land ownership and use within the Region of Influence (ROI) for the three lease sites that are part of the proposed action. The ROI is the land area within and adjacent to the potential lease sites.

Policies and Plans

It is the policy of the Department of the Interior, consistent with Section 2 of the MMPA and Sections 102(a) (7), (8) and (12) of FLPMA, to encourage the development of mineral resources, including geothermal resources, on federal lands. The Geothermal Steam Act of 1970 provides regulatory guidance for geothermal leasing by the BLM.

The Tongass National Forest Land and Resource Management Plan (US Forest Service 2008b) provides general standards and guidelines for minerals. On NFS lands open to mineral entry, the exploration, development and extraction of leasable minerals in encouraged. In addition, the Ring of Fire Resource Management Plan provides direction for mineral leasing on BLM land and BLM-administered subsurface estate in the Alaska Panhandle and Southwest Alaska. The goal outlined in this plan is to maintain or enhance opportunities for mineral exploration and development while maintaining other resource values (Bureau of Land Management 2008). Geothermal development is consistent with these plans.

Regional Setting

The lease areas are located on and near Bell Island in the Tongass NF in the south-eastern Alaskan Panhandle. The 7,680 acres of land are spread across over nine miles, encompassing most of Bell Island as well as a portion of the adjacent mainland. Lands within and adjacent to potential lease areas are owned or administered primarily by the Tongass NF.

There are no designated recreation areas in the lease area. Bell Island Hot Springs is located within the lease area, but is not open to the public. The applicant for the geothermal lease is the owner of the hot springs.

The closest recreational facility to the lease area is Anchor Arm Cabin, located 1.2 miles to the northeast of AK 084543 along the eastern shore of Anchor Arm. The cabin is separated from the lease area by a stretch of water (Bell Arm/Behm Narrows) and an approximately 1,000 foot rise in topography.

Dispersed recreation occurs through the Tongass NF. Popular activities include camping, fishing, kayaking, hunting and wildlife viewing. Due to lack of access to the project area, visitor use is minimal. A former trail that existed on Bell Island is no longer in use and has been abandoned. Bell Island Hot Springs occurs on the western end of the island, but is not open for public use (Kolund 2008).

The nearest population centers are Ketchikan, approximately 43 miles south of the lease area, and Thorne Bay, approximately 46 miles south-west.

Lease Areas

The lease area is classified as semi-remote recreation under the Forest Plan. Lands under the semi-remote recreation classification are intended for semi-primitive recreational use and may include some development. These lands are open to mineral entry including leasable minerals, provided that specific management practices are applied.

Lease AK 084543
This lease site is comprised of approximately 2,500 acres and includes land on Bell Island and ocean waters. Bell Island Hot Springs lies on sections 31 and 36. The only other developed use is a Seaplane ramp in Section 36.

Lease AK 084544
This lease site contains approximately 2,560 acres, comprised of four contiguous sections. There are no developed uses in the lease site.

Lease AK 084545
Lease AK 084544 includes approximately 2,560 acres, comprised of the four contiguous sections. There are no developed uses in this lease site.

Impacts

Alternative A (No Action)
The No Action alternative would have no impact on existing land uses, including existing recreational uses and would not conflict with the Forest Plan.

Alternative B (Proposed Action)
The Proposed Action would not cause any direct impacts on land use or recreation; however, the anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Based on the Reasonably Foreseeable Development Scenario, it is likely that one plant of 20 megawatts will be developed in the lease area. The impacts of a 50 megawatt plant on land uses are discussed in general terms in Section 4 of the PEIS, under *Land Use, Recreation, and Special Designations*.

Impacts on Bell Island Hot Springs are not of concern since the springs are not open to the public, and the geothermal lease applicant is also the owner of the springs. Noise and visual impacts on Anchor Arm Cabin are unlikely due to its distance and topographical separation from the lease area.

There is potential for the development of a geothermal power plant to impact the remote recreational experience currently available in the area; however, due to the minimal usage of the area, impacts on land use are likely to be minimal. If development of a geothermal facility were to improve access to Bell Island, the Proposed Action could result increased recreational opportunities.

The Proposed Action would be consistent with the Forest Plan and current land management classification provided that lease stipulations outlined in Chapter 2 of the PEIS are followed.

Cumulative Impacts
The Proposed Action would not have any cumulative impacts on land use, recreation, or special designations in the lease area; however, anticipated future actions following leasing could contribute to cumulative land use impacts in the

Bell Island area. In combination with the Swan Lake to Tyee Lake Electrical Intertie, development of the lease sites on Bell Island would cumulatively contribute to the trend in land use change on Bell Island from undisturbed conditions to developed condition, including industrial uses. No cumulative impacts on recreation or special designations are expected to result, since recreational use of Bell Island is negligible and there are no areas with special designations in the vicinity.

11.3.3 GEOLOGIC RESOURCES AND SEISMICITY

Setting

The pending lease sites lie within the Pacific Mountain System portion of the Pacific geological province, which extends from southern California through the Kenai Fjords of Alaska. The Pacific province is one of the most geologically young and tectonically active regions in North America. The region straddles the boundaries between several tectonic plates, including the Juan de Fuca, and North American plates (US Geological Survey 2004). Alaska has a complex geology with a mosaic of geologic terranes (pieces the Earth's crust), where each terrane's geologic history is different than that of adjacent terranes. All the terranes in Alaska represent blocks of the earth's crust that have moved large or small distances relative to each other. The movement might have been lateral movement with or without any rotation. Some of the terranes may have moved only a short distance, whereas others may have moved laterally for several hundreds of miles or rotated as much as 135 degrees. The pattern of Alaska terranes reflects the interactions of oceanic crustal plates with the North American plate. Large-scale lateral and rotational movements, rifting, and volcanic activity result from these interactions.

A faultline bisects the island lengthwise. In addition the Queen Charlotte-Fairweather fault runs parallel to the coastal region of the Alaskan panhandle, approximately 100 miles west of the lease area. This fault presents the greatest earthquake hazard to southeast Alaska (US Geological Survey 2003).

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on geological resources, and would not put any people or structures at risk from seismic-related events.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impacts on geologic resources or put people or structures at risk from seismic events; however, the geothermal development activities likely to follow leasing would potentially result in impacts related to inducing seismic events and putting people and structures at risk from seismic events.

Issuing leases for the pending lease sites could indirectly result in the development of geothermal resources at the sites, including increased human presence on the site, and construction of facilities, infrastructure, and transmission lines. Injection of water into a geothermal reservoir during the utilization phase of development could induce seismic activity in the project area. Seismic activity, be it naturally occurring or as a result of injection, could cause damage to structures constructed within the lease site and could cause injury to people within or adjacent to the structures. A seismic event on or near Bell Island could also impact the Swan Lake to Tyee Lake Intertie and, depending on which standards the intertie is designed to meet, potentially could affect electricity transmission to Ketchikan, should the intertie sustain substantial damage. A seismic event on or near Bell Island could also result in impacts on nearby structures such as the Bell Island Hot Springs facility and Yes Bay Lodge.

Potential impacts on any installed geothermal power plant and ancillary facilities would be reduced through implementing the best management practices included in Appendix D under *Geologic Resources and Seismic Setting*.

Prior to allowing injection of fluids into a geothermal reservoir in the lease areas, the FS should consult with the City of Ketchikan regarding potential impacts on the Swan Lake to Tyee Lake Intertie. Project-specific environmental compliance shall consider the seismic safety standards to which the intertie was constructed.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on geologic resources and seismicity in the lease area. Since no projects have been identified in the lease area that would contribute to impacts on geologic resources and seismicity, future actions anticipated to occur following leasing would not cause cumulative impacts in the Bell Island area.

11.3.4 ENERGY AND MINERALS

Setting

The Ketchikan Public Utilities is the largest energy provider in the region. Ketchikan Public Utilities produces and consumes all of the electricity it generates. Sales in 2003 totaled 145,120,668 kWh (Ketchikan Public Utilities 2004).

Ketchikan Public Utilities owns or operates a number of hydro power plants including Ketchikan Lakes Hydro, Beaver Falls Hydro, and Silvis Hydro and Swan Lake Hydro. Total hydro capacity is about 34 megawatts. Construction is underway for additional transmission lines to connect existing hydro plants with additional communities. The Swan Lake to Tyee Lake Intertie is under construction, which would connect Ketchikan's Swan Lake hydroelectric facility with the Tyee Lake facility serving Wrangell and Petersburg. This intertie is the first component of the plan to connect all of the communities in Southwest Alaska within a single power grid (Ketchikan Public Utilities 2004).

The potential for leasable minerals including oil and gas has been determined to be low for the leasing area. No leasable minerals are currently produced on the Tongass NF. Geothermal resources occur in 19 known locations in Southeast Alaska, but development of these resources has been minimal (US Forest Service 2008b)

The Southeast Alaska region has a long history of mineral prospecting and mining. Mining remained active from the late 1800s until WWII. Prospecting and exploration increased again during the mid-1970's, due to additional discoveries as well as advances in technology advances. Due to the continued high prices of gold and other minerals, mining is expected to continue in the area. No mineral activity tracks have been identified in the leasing area. A wide variety of mineral deposit types and mineral resources are found within the Tongass National Forest. Some of these include gold, silver, molybdenum, and uranium, and lead, zinc, copper, tungsten and platinum (US Forest Service 2008b).

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on energy and mineral resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on energy or mineral resources; however, the geothermal development activities likely to follow leasing would likely result in the use of a currently unused geothermal resource and would contribute a renewable form of energy to the City of Ketchikan and other local users. Details on the impacts of geothermal leasing for a standard 50-megawatt plant are included in Section 4.4, *Energy and Mineral Resources*. There would be no other impacts on energy or minerals.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on energy and minerals; however, the geothermal development activities likely to follow leasing could contribute to cumulative energy and mineral impacts in the Alaskan Panhandle. Development of the lease sites in combination with the Swan Lake to Tyee Lake Electrical Intertie project would cumulatively improve the regional, locally-generated and renewable electricity supply. Since the intertie project would not affect mineral or geothermal resources, no cumulative impacts on mineral resources are expected.

11.3.5 SOILS

Setting

AK 084543

Soils in the western section of this lease site are dominated by McGilvery-Lithic Humicryods association at high slopes (75 to 100 percent) and Lithic Cryohemist, Cryosaprist, and Staney soils at low slopes (zero to 35 percent). Eastern sections are composed of McGilvery-Lithic Humicryods association, Histosols and shallow-Calamity-Rock Outcrop associations, with typical slopes of 35 to 75 percent. McGilvery and Cryosaprist soils comprise the central and southern portions of the lease site, at steep slopes of 75 to 100 percent (Silkworth 2008).

AK 084544

Soils in the western section of this lease site are dominated by McGilvery-Lithic Humicryods association, and Lithic Cryohemist, Cryosaprist, and Staney soils at low slopes. McGilvery and Cryosaprist soils dominate the eastern portion of the site. McGilvery-Lithic Humicryods association, Histosols and shallow-Calamity-Rock Outcrop associations, and Lithic Cryohemist, Cryosaprist, and Staney soils comprise the central and southern portions of the lease site. Many small sources of fresh water are also found throughout this site (Silkworth 2008).

AK 084545

Soils at this lease site are dominated by McGilvery and Cryoprist soils in the west and east. Lithic Cryohemists, Cryosaprists and Stanley soils, McGilvery-Lithic Humicrods association, Histosols, and shallow-Calamity-Rock Outcrop associations comprise the central and southern regions (Silkworth 2008). Many small sources of fresh water are also found throughout this site.

There are no prime or unique farmlands within any of the lease sites.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on soils.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on soils; however, anticipated ground disturbance from the geothermal exploration and development activities likely to follow leasing would potentially result in impacts on erosion and soil productivity.

Prior to construction of any facilities or infrastructure, geotechnical investigations would need to be conducted to ensure that any construction be situated on stable soils, and that erosion-prevention measures be implemented in accordance with permitting requirements. Also, project-specific proposals would undergo an evaluation to determine whether proposed ground-disturbing activities are within regional Soil Quality Standards.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on soils in the lease area; however, anticipated future actions associated with development of geothermal resources could contribute to cumulative soil impacts in the Bell Island area. This development could contribute to cumulative soil erosion impacts in the Bell Island area that are also expected to be resulting from timber harvesting and ground disturbance from the Swan Lake to Tyee Lake Electrical Intertie Project. Stormwater and erosion prevention measures outlined in Chapter 2 (lease stipulations) and Appendix D (best management practices) of the PEIS would reduce these cumulative impacts.

11.3.6 WATER RESOURCES

Setting

Surface Water

Bell Island is within the Alaska Southeast hydrologic unit, an area spanning the Alaskan Panhandle. Surface water in Alaska is managed by the Alaska Department of Natural Resources, Division of Mining, Land and Water, Water Resources Program (Alaska Department of Natural Resources 2008). At this time the majority of water in the state has not been assessed or inventoried (US Environmental Protection Agency 2008).

Surface water features at the lease sites are small ponds and lakes concentrated in the north-central region of Bell Island. Three lakes lie along a fault line that runs through the center of the island. These lakes are connected by a stream that empties into the ocean at the southwestern tip of the island (Huette 2008). Bell Island Hot Springs is located on that same tip of the island and has about a discharge rate of about 100 gallons per minute and a temperature of about 70 degrees Celsius (Motyka et al. 1980).

No research is currently available regarding water quality within the lease sites. Due to the undeveloped nature of Bell Island, surface water resources are expected to be pristine, with little to no contamination.

Ground Water

The aquifers of Alaska have never been mapped, except in the immediate vicinity of some of the towns and cities. Igneous, metamorphic, and sedimentary rocks underlie approximately 70 percent of the state. These rocks generally yield smaller amounts of water to wells than coarse-grained alluvial and outwash deposits. Carbonate bedrock on some islands in southeastern Alaska yields large quantities of water from well-developed cave systems. In general, the water-yielding capacity of bedrock in Alaska is not well known. Several coarse-grains

Quaternary deposits that may locally comprise aquifers are found within the region of the lease site, however none are know to occur within or immediately adjacent to the site (US Geological Survey 1994).

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on water resources.

Alternative B (Proposed Action)

Water Quality

The Proposed Action would not have any direct impact on water quality; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in impacts on water quality. Typical impacts on water quality from geothermal development are described in Section 4.7, *Water Resources*. Best management practices for water resources, included in Appendix D, would reduce impacts on water quality.

Water Quantity

The Proposed Action would not have any direct impact on water quantity; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in impacts on water quantity, since indirect use geothermal projects require large amounts of water during all phases of a project from exploration through reclamation and abandonment. Both groundwater and surface waters are abundant in the lease area, and no impacts on existing water resources are expected.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on water quality or quantity in the lease area; however, anticipated future actions associated with development of geothermal resources could contribute to cumulative water quality impacts in the Bell Island area. Geothermal development activities, combined with surface activities associated with the intertie project, could cumulatively impact surface water quality through ground disturbance, discharges of geothermal fluids, and stormwater runoff. Groundwater quality could be cumulatively impacted through on-site spills of petroleum products and other chemicals used during construction and maintenance of facilities, as well as from discharges of geothermal fluids to the surface. Lease stipulations (Chapter 2) and best management practices (Appendix D) of the PEIS would reduce these potential cumulative impacts.

11.3.7 AIR QUALITY AND ATMOSPHERIC VALUES

Setting

The lease area is located in Ketchikan Gateway Borough, an area with air quality status of Unclassified. Due to the remote location of the lease sites, air quality is considered to be good.

The lease site is within a maritime climate zone that includes southeastern Alaska, the south coast, and southwestern islands. The closest weather monitoring station to the lease site is at Ketchikan, Alaska, approximately 43 miles south of the lease area. The coastal mountain range coupled with plentiful moisture produces annual average precipitation amounts of approximately 150 inches at Ketchikan. Average maximum temperatures at Ketchikan range from 38.9 degrees Fahrenheit in January, to 65.0 degrees Fahrenheit in August, with average minimum temperatures ranging from 28.4 degrees Fahrenheit in January, to 51.6 degrees Fahrenheit in August (Western Regional Climate Center 2007).

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on air quality or atmospheric values.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on air quality or atmospheric values; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Geothermal exploration and development activities would result in fugitive dust and exhaust from combustion engines, but these emissions would not result in violations of ambient air quality standards given the Unclassified status of the borough and the good level of existing air quality.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on air quality and atmospheric values in the lease area. Construction of the intertie project is expected to be complete prior to any geothermal development activities, and the intertie project is not expected to result in any ongoing air emissions; therefore, no cumulative air quality and atmospheric values impacts are expected from anticipated future activities following leasing.

11.3.8 VEGETATION

Setting

There are three lease application sites that occur on NFS lands, covering the majority of Bell Island. Bell Island is located within coastal forest of southeast Alaska; a cool temperate rainforest that extends along the Pacific coast from northern California to Cook Inlet in Alaska. Lands within the lease sites rise from approximately 300 feet elevation to 2,235 feet. The natural plant communities in the lease area is dominated by old-growth conifers; primarily western hemlock (*Tsuga heterophylla*) and Sitka spruce (*Picea sithcensis*), with a scattering of mountain hemlock (*Tsuga mertensiana*), western redcedar (*Thuja plicata*), and Alaska yellow cedar (*Callitropsis nootkatensis*). Blueberry (*Vaccinium sp.*), Sitka alder (*Alnus viridis ssp. sinuata*), Devil's club (*Oplopanax horridus*), and salal (*Gaultheria shallon*) are common shrubs in the lease area and throughout the Tongass National Forest. Other understory species include dogwood (family *Cornaceae*), single delight (*Moneses uniflora*), and skunk cabbage (*Lysichiton americanus*). Because of the high rainfall and resulting high humidity, mosses grow in great profusion on the ground, on fallen logs, on the lower branches of trees, and in forest openings. Muskeg (bog plant) communities, dominated by sphagnum mosses and sedges, occur on flat areas of Bell Island (Huette 2008).

Invasive Species

Invasive species are considered to be plants that have been introduced into an environment where they did not evolve (Bureau of Land Management 2008). Invasive species can have dramatic impacts on the natural ecosystem by reducing habitat for native vegetation, as well as, altering forage and wildlife habitat. Invasive species reduce the productivity of healthy rangelands, forestlands, riparian areas, and wetlands. Eradication of these species is intensive, time consuming, and costly.

Alaska is just beginning to document and address problems associated with invasive plants. Recent surveys by the Alaska Cooperative Extension Service, Alaska Department of Natural Resources, BLM, US Fish and Wildlife Service, National Park Service, and the US Forest Service show that more non-native plants occur in the state than previously thought, but population size is still relatively manageable. Common invasive species include reed canarygrass (*Phalaris arundinacea*), spotted knapweed (*Centaurea biebersteinii*), orange hawkweed (*Hieracium aurantiacum*), white sweet clover (*Melilotus alba*), and bull thistle (*Cirsium vulgare*). Invasive plant problems are being addressed on the Tongass National Forest via recently signed invasive plant management plans (US Forest Service 2006a). Records of invasive plant surveys within the lease were not available.

Special Status Species

There are no federally listed or proposed threatened or endangered plants that are expected on Bell Island (US Forest Service 2006b, Huette 2008).

Old-Growth Forests

Old growth is characterized by a patchy, multi-layered canopy; trees that represent many age classes; large trees that dominate the overstory, standing dead (snags) or decadent trees; and higher accumulations of down woody material. The structure and function of an old-growth ecosystem will be influenced by stand size, landscape position, and juxtaposition with other elements of the landscape (Huette 2008).

Medium and high volume productive old growth forest is concentrated along the coast of Bell Island and the neighboring mainland. A corridor of medium and high volume productive old growth runs lengthwise through the island (Huette 2008).

Wetlands/Riparian Areas

With the exception of old-growth areas, the majority of Bell Island is wetland. Interior areas are dominated by freshwater emergent wetland, giving way to a freshwater forested/shrub wetland that continues up to forest edges. Adjacent mainland coastal areas are characteristically similar. Two lakes lie in the center of the island within lease sites AK 084543 and 084544, connected by a stream that runs lengthwise towards the western tip of the island and emptying into the ocean. Two freshwater ponds occur within lease sites AK 084544 and 084545 (US Fish and Wildlife Service 2008c).

Impacts

Potential impacts on vegetation and important habitats could occur if reasonably foreseeable future actions were to:

- Affect a plant species, habitat, or natural community recognized for ecological, scientific, recreational, or commercial importance;
- Affect a species, habitat, or natural community that is specifically recognized as biologically significant in local, state, or federal policies, statutes or regulations;
- Establish or increase of noxious weed populations;
- Destroy or extensively alter habitats or vegetation communities in such a way that would render them unfavorable to native species; or
- Conflict with BLM or FS management strategies.

Alternative A (No Action)

The No Action alternative would have no impact on vegetation or important habitats.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on vegetation or important habitats or communities; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in impacts associated with the elimination and degradation of habitat. Geothermal exploration and development activities can cause the following stressors and associated impacts on vegetation and important habitats:

- Habitat disturbance – Site clearing, well drilling, construction of access roads and geothermal facilities, as well as maintenance and operational activities would disturb habitat which would cause mortality and injury, increased risk of invasive species, and alter water and seed dispersion, as well as wildlife use, which can further affect vegetation communities.
- Direct Removal and Injury – Vegetation would be cleared for roadways, vehicle staging, buildings, pipelines, and transmission lines. All merchantable sawlog and utility grade logs would be purchased and paid for by the permittee from USDA Forest Service Region 10 under a timber settlement agreement prior to felling any merchantable trees. Activities could result in loss of soil, loss of seed bank in soil, deposition of dust, and destruction of biological soil crusts. Maintenance around project components, such as drill pads, buildings, pipelines, or other facilities would involve mowing, herbicide treatment, and other mechanical or chemical means of removal and control. This would result in a net loss of important habitats and communities throughout the planning area.
- Invasive Vegetation – Disturbance and access by vehicles and human foot traffic may expose areas to colonization by invasive and non-native species, making it more difficult for endemic species to reestablish in disturbed areas and threatening the continued existence of endemic species (Bureau of Land Management 2007).
- Fire – Increased vehicular and human traffic, operation of equipment, the use of drilling muds, and the extraction of geothermal fluids can increase the risk of fires. Vehicles, electrical lines, and cigarette smoking can all result in accidental fires. Fires destroy vegetation and can aid in the establishment of invasive species.
- Erosion – Site clearing, grading, construction of access roads, containment basins, site runoff and vehicle and human foot traffic cause erosion. The effects of erosion include the removal of top soil, loss of seed bank, loss of native vegetation, the establishment of invasive species, the sedimentation of streams, and flooding (which can directly result in affects to riparian vegetation and riparian habitats).
- Exposure to Contaminants – Vehicle fuel, hydraulic fluid, solvents, cleaners, and geothermal fluids can all be harmful to vegetation and important habitats. Accidental spills can contaminate soils and water and directly harm vegetation. Licensed herbicide use would likely be used to control vegetation around geothermal facilities and support structures. Spills of herbicides or acute exposure to herbicides can have adverse affects on non-target vegetation.

Table 3.9-1 in Section 3.9 of Volume I of the PEIS provides a breakdown of the likelihood for impacts to occur during each phase of geothermal development (exploration, drilling operations and development, utilization, and reclamation and abandonment).

Riparian and Wetland Habitat

Both freshwater emergent and freshwater forest/shrub wetlands lie within the lease area and may be affected by anticipated future activities following leasing. The construction of roadways, drill pads, facility foundations and other support structures may require the conversion and fill of wetlands. These actions can cause impacts on hydrology, water quality, soil productivity, and fish and wildlife habitats. Chapter 4 of the PEIS provides more specific detail on the potential impacts on wetland habitats associated with geothermal activities.

Impacts on wetlands are regulated under the River and Harbors Act and Section 404 of the Clean Water Act. Permitting from the U.S. Army Corps of Engineers (Corp) would be required if future development at the site would have any impact to wetlands under Corps' jurisdiction. In addition, E.O. 11990, "Protection of Wetlands," requires all federal agencies to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on vegetation and important habitats in the lease area; however, anticipated future actions associated with development of geothermal resources could contribute to cumulative impacts on vegetation and important habitats in the Bell Island area. In combination with the Swan Lake to Tyee Lake Electrical Intertie, development of the lease sites on Bell Island would cumulatively contribute to loss in vegetation and important habitats, and increased impacts on wetlands and riparian habitat.

11.3.9 FISH AND WILDLIFE

Setting

There are over 300 vertebrate species that inhabit the Tongass National Forest at some point in their life cycle, including 231 birds, 54 mammals, and 5 species of amphibians and reptiles (Silkworth 2008). Common species include Sitka black-tailed deer, (*Odocoilues hemionus sitkensis*), brown bear (*Ursus arctos*), American marten (*Martes americana*), and red squirrel (*Tamiasciurus hudsonicus*). Noted bird species include the bald eagle (*Haliaeetus leucocephalus*), Queen Charlotte goshawk (*Accipiter gentilis laingi*), common raven (*Corvus corax*), and a variety of coastal shorebirds. The temperate rainforest provides nesting and foraging habitat for a variety of forest species. Twelve types of cavity and bark-nesting birds, including the hairy woodpecker (*Picoides villosus*) and red-breasted sapsucker (*Sphyrapicus ruber*) occur in the area. Forest- and shrub-nesting species found in the area include flycatchers, forest raptors, crossbills, kinglets, and warblers such as the Townsend's warbler (*Dendroica townsendi*), which favor large spruce trees, such as those found throughout the lease area. The region's wetlands provide habitat for numerous waterfowl. The Pacific Flyway passes through the area and as many as 30 percent of local avian species migrate to the southern US, Central America or South America (US Forest Service 2008c).

Streams on Bell Island and within the lease areas are known to support several salmon species. Fish Pass Feasibility and Habitat Survey of Bell Creek, which is within lease area AKAK 084543, conducted in 2003 recorded the presence of pink (*Oncorhynchus gorbuscha*) and coho salmon (*O. kisutch*). This stream is also a cataloged as an ADG&G anadromous stream (#101-80-10990) supporting coho, chum (*O. keta*), pink, and steelhead (*O. mykiss*). Dolly Varden char (*Salvelinus malma malma*) and cutthroat trout (*Oncorhynchus clarki*), FS management indicator species, also occur in the area and depend of freshwater habitat (Silkworth 2008). Several species of fresh- and salt-water sculpins (*Hemilepodotus sp.*) occur within the area and three-spine stickleback (*Gasterosteus aculeatus*) are common in freshwater lakes in the region (Wipfli 2005).

A total of eight amphibian species are known to exist in Southeast Alaska (MacDonald and Cook 2007). Amphibian populations in throughout Alaska are not well understood because of their limited breeding range and isolated populations. Both rough-skinned newts (*Taricha granulosa*) and western toads (*Bufo boreas*) have been documented on islands adjacent to Bell Island, and wood frog (*Rana sylvatica*), spotted frog (*Rana pretiosa*) and long-toed salamander (*Ambystoma macrodactylum*) populations have been documented on the nearby mainland (US Forest Service 2008b). The major stressor negatively affecting terrestrial wildlife in the area is logging; however, the majority of the Tongass National Forest has been conserved for wilderness and recreational purposes, greatly reducing impact from the timber industry (Silkworth 2008).

Impacts

Impacts on fish and wildlife would occur if reasonably foreseeable future actions were to:

- Adversely affect a population by substantially reducing its numbers, causing a fish or wildlife population to drop below self sustaining levels or causing a substantial loss or disturbance to habitat, such effects could include vehicle impacts and crushing, increased predation, habitat fragmentation, or loss of seasonal habitat;
- Have a substantial adverse impact on nesting migratory birds, including raptors, as protected under the Migratory Bird Treaty Act;
- Interfere with the movement of any resident or migratory fish or wildlife species, or with established native resident or migratory

wildlife corridors, or impede the use of native wildlife nursery sites; or

- Conflict with the wildlife management strategies of the FS.

Alternative A (No Action)

The No Action alternative would have no impact on fish and wildlife.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on fish and wildlife; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts, as described below.

Fish

Fish species in the lease area could be affected by several activities. Impacts on fish and aquatic biota from development in the lease area would be linked to impacts on riparian habitats and immediately adjacent upland habitat. Ground disturbance, vegetation removal, ground water withdrawal, road construction and excavation, installation of structures and other facilities, such as transmission towers or pipelines, and release of water contaminants could affect fish species residing in streams in the project area, such as pink and coho salmon, steelhead trout, and Dolly Varden char. Changes in hydrology, increased turbidity, changes in water quality (temperature, dissolved oxygen, pollutants, etc), loss of riparian vegetation (an indirect aquatic food source), restriction of fish movement and migration, and changes in predator and human use of the aquatic habitat are all potential impacts associated with development of the lease area. The Chapter 4 of Volume I of the PEIS provides a more complete analysis of the potential impacts on fish resulting from geothermal activities, as well as impacts on riparian and wetland habitat that could affect fish and other aquatic biota.

Essential Fish Habitat

The Magnuson-Stevens Fisheries Conservation and Management Act, or Magnuson-Stevens Act, as amended by the Sustainable Fisheries Act of 1996 (PL 104-267), established procedures designed to identify, conserve, and enhance Essential Fish Habitat for species regulated under a federal fisheries management plan. The Magnuson-Stevens Act defines Essential Fish Habitat as those waters and substrate necessary for fish use in spawning, breeding, feeding, or growth to maturity. The Magnuson-Stevens Act requires federal agencies to consult with the National Marine Fisheries Service regarding activities that may adversely affect Essential Fish Habitat. Essential Fish Habitat consultations are intended to determine whether proposed projects would adversely affect designated Essential Fish Habitat and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to Essential Fish Habitat. The implementing regulations for Magnuson-Stevens Act allow for the integration of NEPA or Endangered Species Act Section 7 reviews with the analysis of proposed project effects on Essential Fish Habitat.

Pursuant to the Magnuson-Stevens Act, the Pacific Fisheries Management Council has designated Essential Fish Habitat for all stocks of Pacific salmon. Freshwater Essential Fish Habitat for salmon includes all streams, lakes, ponds, wetlands, and other water bodies currently or historically accessible to salmon in Alaska. The four major components of Essential Fish Habitat for these species consist of (1) spawning and incubation habitat, (2) juvenile rearing habitat, (3) juvenile migration corridors, and (4) adult migration corridors and adult holding habitat.

Essential Fish Habitat potentially affected by geothermal activities at the lease areas may occur in the streams that pass through or are immediately adjacent to the lease areas, as well as stream estuaries.

Wildlife

Terrestrial wildlife species could be displaced during the removal of habitat or development of geothermal facilities. Small ground dwelling species, such as small mammals, could be crushed by vehicle traffic and clearing activities. Fire can cause direct mortality. Vehicles, cigarette smoking, and power lines can cause wildfires that can kill and displace animal species, especially smaller and less mobile animals. Invasive vegetation introduced during exploration and development activities can alter wildlife habitat, making it less suitable for habitation.

The lease sites provide habitat for a variety of resident and migratory birds. The FS is required to analyze the impacts of any action on migratory birds, under the Migratory Bird Treaty Act. The likelihood of disturbing nests of such birds is limited primarily to breeding and nesting seasons (spring and summer). Lease stipulations to avoid disturbance during the migratory bird nesting season, so as not to violate the Migratory Bird Treaty Act, would reduce the potential for significant impacts on migratory birds. Waterfowl, raptors, and small birds that depend on particular forest types as a source of food or cover could be vulnerable to loss of habitat within the lease area. Removing timber and other vegetative cover could affect foraging and nesting behavior.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on fish and wildlife; however, anticipated future actions associated with development of geothermal resources would contribute to cumulative impacts on fish and wildlife in the Bell Island area. In combination with the Swan Lake to Tyee Lake Electrical Intertie, development of the lease sites on Bell Island and an increased human activity on the lease sites would cumulatively contribute to loss and decreased quality of fish and wildlife habitat.

11.3.10 Threatened and Endangered Species and Special Status Species

Setting

This section provides an overview of threatened, endangered, and special status species, and their habitats that may occur in the lease area. Special status species are those identified by federal or state agencies as needing additional management considerations or protection. Federal species are those protected under the ESA and those that are candidates or proposed for listing under the ESA. State sensitive species are those considered sensitive by the Alaska Department of Fish and Game. A list of sensitive species that may occur in the lease area is provided below based on discussion with Forest Service biologists and review of appropriate documents as referenced.

There are no federally listed species known or expected to occur in or immediately adjacent to the lease area. Humpback whales (endangered) and Steller's sea lion (threatened) are likely to occur in the marine waters adjacent to Bell Island, but would not be affected by geothermal activities. Region 10 Forest Service sensitive species with potential to occur on Bell Island include Queen Charlotte goshawk and trumpeter swan (*Cygnus buccinators*). No surveys have been conducted for these species on the island.

Nineteen vascular plants are designated as sensitive in the Alaska Regional Forester's revised Sensitive Plant Species List of June 2002. Plant species included on the list that are known or expected to occur on Bell Island are found in Table 11.3-1 below.

Table 11.3-1
Forest Service Region 10 Sensitive Plant Species
Known or Expected to Occur on Bell Island.

Scientific Name	Common Name	Occurrence
Arnica lessingii ssp norbergii	Norberg arnica	Suspected
Botrychium tunux	Unnamed moonwort	Suspected
Botrychium yaasudakeit	Unnamed moonwort	Suspected
Carex lenticularis	Goose-grass sedge	Known
Glyceria leptostachya	Davy mannagrass	Suspected
Hymenophyllum	Wright filmy fern	Suspected
Isoetes truncate	Truncate quillwort	Suspected
Ligusticum caldera	Calder lovage	Suspected
Platanthera gracilis	Bog orchid	Known
Poa laxiflora	Loose-flowered bluegrass	Suspected
Romanzoffia unalaschencensis	Unalaska mist-maid	Suspected
Senecio moresbiensis	Queen Charlotte butterweed	Known

Source: US Forest Service 2006

Impacts

Impacts on threatened and endangered and special status species would occur if reasonably foreseeable future actions were to:

- Violation the Endangered Species Act, the Migratory Bird Treaty Act, or applicable state laws; or
- Decrease a plant or wildlife species population to below self-sustaining levels.

Alternative A (No Action)

The No Action alternative would have no impact on special status species.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on threatened and endangered and special status species; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Threatened and endangered species (including federal and state listed species and FS special status species) could be affected as a result of (1) habitat disturbance, (2) the introduction of invasive vegetation, (3) injury or mortality, (4) erosion and runoff, (5) fugitive dust, (6) noise, (7) exposure to contaminants, and (8) interference with behavioral activities.

Because of the regulatory requirements of the Endangered Species Act and various state regulations, as well as the requirements specified in BLM Manual 6840 Special Status Species Management and other resource-specific regulations and guidelines, appropriate survey, avoidance, and mitigation measures would be identified and implemented prior to any geothermal activities to avoid adversely affecting any sensitive species or the habitats on which they rely.

Cumulative Impacts

Neither the Proposed Action nor any anticipated future actions associated with development of geothermal resources following leasing would have any cumulative impacts on threatened and endangered and special status species in the lease area, as none are known to exist. Additionally, because of the regulatory requirements of the Endangered Species Act, various state regulations, and other resource-specific regulations and guidelines, appropriate survey, avoidance, and mitigation measures would be identified and implemented prior to any geothermal activities to avoid adversely affecting any sensitive species or the habitats on which they rely.

11.3.11 Cultural Resources

Setting

Cultural resources are past and present expressions of human culture and history in the physical environment and include prehistoric and historic archaeological sites, structures, natural features, and biota that are considered important to a culture, subculture, or community. Cultural resources also include aspects of the physical environment that are a part of traditional lifeways and practices and are associated with community values and institutions.

As in the PEIS, discussions relevant to cultural resources in this document are found in two sections. Traditional cultural resources and traditional cultural properties are addressed in Section 11.3.13, *Tribal Interests and Traditional Cultural Resources*. Cultural resources in this section include the physical remains of prehistoric and historic cultures and activities.

All three leases in Alaska are within the Northwest Coast culture region, as described broadly in the Appendix I of the PEIS. De Laguna (1990) provides an ethnographic overview of the project area within the larger Northwest Coast culture region. The following discussion is based primarily on that overview. The Alaska leases are considered to be within the traditional territory of Southern Tlingit-speaking groups. That area is further broken down into dialects of Tlingit, the lease area being on or near the boundary of the Sanya and Stikine dialects.

As outlined in Appendix I, the earliest people to inhabit this area are referred to as Paleoindian, though there is little archaeological evidence that has been attributed to these populations. However, this may be due to the effects of sea level rise (Bureau of Land Management 2008; Neusius and Gross 2007). The archaeology of later prehistoric and historic periods is better documented due to the number of non-native populations arriving in the region beginning in the 1700s. A common focus for much of Alaskan prehistoric research is early migration from Eurasia into North America along the Pacific coast. A site on Prince of Wales Island to the west of the project area has returned early dates of approximately 9,900 years ago (Bureau of Land Management 2008).

Traditional legends indicate that most Tlingit believe their ancestors first entered the area from the Tsimshian peninsula, while later groups from the interior migrated to this coastal region down rivers. Several population movements occurred in the culture region over time, primarily in response to other population movements. In each Tlingit tribal area there was at least one main village that was occupied in the winter and typically deserted in the summer. These were most often situated on a sheltered bay with a sandy beach and views of the surrounding access routes. Villages were characterized by a row of large wood plank houses facing the water with a cemetery at one end (or on an adjacent island) and relatively easy access to subsistence resources. In the project area tall mortuary totem poles were erected beside or in front of the houses. Shamanistic regalia were stored in boxes in the surrounding woods. Satellite fishing and hunting camps were established and used during the summer. Early springs were spent hunting and trapping terrestrial mammals, and fishing in deep waters and in rivers, and collecting shellfish and seaweed along the coast. During late spring through fall, many people hunted for sea otter and fur seals. Salmon was caught and cured and vegetal resources were collected during the summer as well. Fishing trips were often made upriver during early spring or late summer, with groups wintering in the interior, and returning downriver the following spring. When rivers were frozen over in the winter, many mainland populations took the opportunity to travel inland for trade. Tlingits primarily traded between "partners" in a system known as the "potlatch" (De Laguna 1990).

A variety of historic-era activities have been documented within the region of the Alaska leases. Alaska was originally explored by the Russians who established political boundaries. The state was later purchased by the U.S. in 1867 (De Laguna 1990; Bureau of Land Management 2008). During the period of Russian occupation Tlingits maintained an independence living away from Russian forts in Sitka and Wrangell, to the northwest and north of the project area respectively. However goods were acquired at the forts although Tlingit canoes were traveling as far south as Puget Sound for the purposes of trade. Following purchase of Alaska by the U.S. Tlingits became increasingly involved in the Euro-American economies (De Laguna 1990). The state became part of the Union in 1959, however settlement between the Tlingit and the U.S. regarding lands taken from the Tlingit was not reached until 1968 (Bureau of Land Management 2008). Throughout this history historic activities of the region have included fur trapping and trade, fish canneries, emigration and settlement by Euro-Americans and Canadians, mineral mining, including the Klondike Gold Rush, trade between Native Americans and Euro-Americans, trail and railroad establishment (De Laguna 1990; Bureau of Land Management 2008).

Data on cultural resources of the proposed lease areas were provided in April 2008 by Martin Stanford, Archaeologist for the Ketchikan-Misty Fiords Ranger District of the Tongass NF. The seven survey reports provided revealed the presence of two previously recorded cultural resources within the lease areas, one within each of AK 084543 and 084545. The entirety of the shoreline within all three leases has been previously surveyed. Surveys of the shorelines in the area have identified numerous rock art sites. The inland portions of the leases have had minimal survey coverage that included portions of the valley that runs the length of Bell Island. The overwhelming majority of the leases have not been previously surveyed.

Bell Island Hot Springs (AK-Ket-007) is within the southeastern portion of AK 08543. A variety of historic-era activities occurred here. A log cabin was constructed in the 1880s by a mink trapper. Later pioneers stopped at this location to soak in the hot springs and by 1899 a dwelling and a bath house had been constructed. As of a 2006 survey, remaining structures from the trapper's cabin and the bath house still remained (Stanford 2006). It appears that this site has not been previously evaluated for National Register of Historic Places (NRHP) eligibility.

The Anchor Pass Stake Weir site (AK-Ket-097) is within the eastern extent of AK 084545. This prehistoric, NRHP-eligible site consists of two sets of four stone piles and a possible "wolf trap" pool located in the intertidal area. One set of the rock piles is described as resembling a dock or mooring for a boat. Subsurface testing in the area revealed no cultural materials (Historical Research Associates, Inc. undated).

Consultation with federally-recognized tribes that are affiliated with the lease area was initiated on September 12, 2007 to identify and assess historic properties that may be affected by the undertaking. No responses from local tribes have been received as of the date of publication; however consultation is considered on-going. Until consultation with local Native Americans has been completed, it is unknown if there are Native American sites or sacred sites within or adjacent to the lease areas. The presence of cultural resources within portions of the leases not previously surveyed is also possible. Table 11.3-2 summarizes available data on the cultural resources of the proposed lease areas.

Table 11.3-2
Cultural Resources in the Proposed Lease Areas

Lease	Surveys (Acres/Percent)	NRHP-listed sites	NRHP-eligible sites	NRHP-ineligible sites	Unevaluated sites
AK 054543	<10%	N/A	N/A	N/A	1
AK 054544	<10%	N/A	N/A	N/A	N/A
AK 054545	<10%	N/A	N/A	N/A	1

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on cultural resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on cultural resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Completion of the Section 106 process of the National Historic Preservation Act requires the BLM and FS to consult with the State Historic Preservation Office, tribes and other parties to identify and assess historic properties affected by the undertaking and develop measures to avoid, minimize, or mitigate any adverse effects of the undertaking on historic properties.

Given the presence of NRHP-eligible resources and the overall lack of terrestrial surveys within the pending lease sites, indirect and secondary impacts on cultural resources could occur from subsequent permitted geothermal exploration, drilling operations and development, utilization, and reclamation and abandonment through ground-disturbing activities, unauthorized actions and alterations to setting and cultural landscapes. The nature of these impacts is described in Chapter 4 of Volume I of the PEIS. Additionally, as described in Chapter 2 of Volume I of the PEIS, various areas of cultural resources would have No Surface Occupancy stipulations: National Landmarks, National Register Districts, NRHP-listed and -eligible sites and their associated landscapes, traditional cultural properties, Native American sacred sites, and areas with important cultural and archaeological resources. Areas of potential effect would include access roads, well pads, power plant footprints, pipeline and transmission line routes, and construction staging areas as well as the boundaries of cultural resources those facilities cross and the aspects of setting that contribute to significance. These areas of potential effect would be developed at the project-specific level, and would require inventories, evaluations, and appropriate treatments as outlined in the best management practices of Appendix D in Volume III of the PEIS. Under these cultural resources best management practices, the BLM would also conduct Section 106 consultations with the State Historic Preservation Office, Native American tribes with ties to the project area, and local historic preservation groups to identify the presence and significance of cultural resources within or adjacent to the lease area and assess the level of impact of geothermal exploration and development on those resources. Project-specific impacts from actions following leasing would be reduced by implementing these best management practices.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on cultural resources; however, anticipated future actions associated with development of geothermal resources could cause such impacts. Past ground-disturbing activities and the Swan Lake to Tyee Lake Intertie project undoubtedly have had and will have effects on cultural resources given the regional density of resources and general lack of terrestrial survey coverage. Presumably past activities would have mitigated impacts to a less than significant level through re-design, data recovery, or other similar methods. Any effects from the anticipated future actions following leasing would be mitigated to a less than significant level through implementation of best management practices during the permitting process.

11.3.12 Tribal Interests and Traditional Cultural Resources

Setting

Tribal interests include economic rights such as Indian trust assets, and resource uses and access guaranteed by treaty rights. Traditional cultural resources or properties include areas of cultural importance to contemporary communities, such as sacred sites or resource gathering areas. While most commonly considered in the context of Native Americans and Native Alaskans, there are traditional cultural resources associated with other ethnic or socially linked groups.

All three pending lease sites in Alaska are within the Northwest Coast culture region, as described broadly in the Appendix I of the PEIS. De Laguna (1990) provides an ethnographic overview of the project area within the larger Northwest Coast culture region. The following discussion is based primarily on that overview. The Alaska leases are considered to be within the traditional territory of Southern Tlingit-speaking groups. That area is further broken down into dialects of Tlingit, the lease area being on or near the boundary of the Sanya and Stikine dialects.

Traditional legends indicate that most Tlingit believe their ancestors first entered the area from the Tsimshian peninsula, while later groups from the interior migrated to this coastal region down rivers. In the project area tall mortuary totem poles were erected beside or in front of traditional houses. Shamanistic regalia were stored in boxes in the woods surrounding villages. Tlingit religion considers all living things, natural features, and celestial bodies to have a spirit or soul. Even some manufactured items were at times thought to embody such characteristics. After death, Tlingits were thought to enter a separate plane of existence and then be reincarnated (De Laguna 1990).

Consultation with federally-recognized tribes that are affiliated with the lease area was initiated on September 12, 2007 to identify and assess tribal concerns and traditional resources that may be affected by the undertaking. No responses from the tribes have been received as of the date of publication; however, the consultation process is considered on-going. While many traditional cultural resources are well known, some locations or resources may be privileged information that is restricted to specific practitioners or clans. For tribes, maintaining confidentiality and customs regarding traditional knowledge may take precedence over identifying and evaluating these resources, unless they are in imminent danger of damage or destruction.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on tribal interests and traditional cultural resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on tribal interests and traditional cultural resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Impacts on Tribal Interests and Traditional Cultural Resources are assessed using the criteria found in Chapter 4 of Volume I the PEIS. Although no tribal interests or concerns have been identified by the consultation process, the process is considered on-going and such resources may be identified in the future by tribes. Impacts on Tribal Interests would be minimized or avoided by implementing best management practices in Appendix D of Volume III of the PEIS for each of the phases of the Reasonably Foreseeable Development scenario as described in Chapter 2 of Volume I of the PEIS.

For traditional cultural resources, completion of the Section 106 process of the National Historic Preservation Act requires the BLM and FS to consult with the State Historic Preservation Office, tribes and other parties to identify and assess historic properties affected by the undertaking and develop measures to avoid, minimize, or mitigate any adverse effects of the undertaking on historic properties which includes traditional cultural properties. No Traditional Cultural Resources have been identified by consulted tribes thus far, but consultation is considered on-going. Additionally, archaeological resources such as those discussed in Section 11.3.11, *Cultural Resources*, are often considered traditional resources by tribes.

Impacts on traditional cultural resources could occur from anticipated future actions following leasing, such as exploration, drilling, utilization, and reclamation and abandonment through ground-disturbing activities, unauthorized actions, and alterations to setting and cultural landscapes. The nature of these impacts and mitigations are described in Chapter 4 of Volume I of the PEIS. Areas of potential effect would include access roads, well pads, power plant footprints, pipeline and transmission line routes, and construction staging areas as well as the aspects of setting that contribute to significance. These areas of potential effect would be developed at the project-specific level, and would require inventories, evaluations, and appropriate treatments as outlined in the best management practices of Appendix D in Volume III of the PEIS. Under these cultural resources best management practices, the BLM would also conduct Section 106 consultations with the State Historic Preservation Office, Native American tribes with ties to the project area, and local historic preservation groups to identify the presence and significance of cultural resources within or adjacent to the lease area and assess the level of impact of geothermal leasing and development on those resources. Project specific impacts after leasing would be reduced by implementing these best management practices.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on tribal interests and traditional resources; however, anticipated future actions associated with development of geothermal resources could cause such impacts. Past ground-disturbing activities and the project identified in Section 11.1.6, *Cumulative Projects*, may have had and may have effects on tribal interests and traditional resources given the regional density of cultural resources and general lack of terrestrial survey coverage. Presumably past activities would have mitigated impacts to less than significant levels through re-design, data recovery, oral histories, or other similar methods. Any effects from anticipated future actions following leasing would be mitigated to less than significant levels through implementation of best management practices during the permitting process.

11.3.13 Visual Resources

Setting

This section describes the visual resources in the region of influence, which is defined as the areas within and immediately surrounding the proposed lease areas. Described below is the method for managing scenic resources and the visual landscape of the lease areas.

The Forest Service's Scenery Management System is a tool for inventorying and managing scenic resources and classifies lands into the following seven Scenic Integrity Objectives:

- Very High
- High
- Moderate
- Low
- Very Low
- Unacceptably Low
- Unknown

According to the Tongass Land and Resource Management Plan Final Environmental Impact Statement Plan Amendment, the Tongass National Forest offers a variety of scenery to its visitors, from spectacular mountain ranges and the glaciers of the mainland to low-lying marine landscapes composed of intricate waterways, bays, and island groups (US Forest Service 2008b). The Forest is viewed from a variety of vantage points, including the communities of Southeast Alaska, the Alaska Marine Highway ferry route, cruise ship routes, existing road systems, popular small boat routes and anchorages, developed recreation sites and facilities, and hiking trails. Tourist-related flight seeing via small aircraft is increasing in popularity and provides aerial views of the forest landscape.

Bell Island is north of Revillagigedo Island, northeast of Spacious Bay, and southwest of Boroughs Bay. Most of the proposed lease areas are on most of Bell Island, and a portion is on the adjacent mainland. There are no bridges to this semi-remote island. There are no developed uses modifying the characteristic landscape of the proposed lease areas.

Bell Island is approximately 8 miles long, approximately 3 miles wide, and situated in a northeast to southwest position. The highest point on Bell Island is at approximately 2,500 feet and is at the northeast end of the island. Bell Island

Lakes, as well as hot springs, are at the southwestern end of the island. Creeks are also visible in various areas of Bell Island.

The landscape of Bell Island is similar to the surrounding islands and mainland. The terrain has a strong undulating appearance. Vegetation uniformly covers the terrain and is of varying heights and maturity. Bays and inlets pierce in to low-lying coastal areas, and lakes fill in interior depressions.

Boats or seaplanes may be seen on the water around Bell Island. Appendix F of the Forest Plan lists routes and use areas from which scenery will be emphasized (US Forest Service 2008b). Bell Island is a visual priority route for small boats and mid-size tour boats, and Bell Island Trail #927030 is a visual priority use area. There are no sources of light in the lease areas.

Impacts

The Tongass National Forest was unable to provide Scenic Integrity Objective classification for Bell Island. For the purpose of this analysis, it is assumed the lease areas on FS land are designated with a Moderate Scenic Integrity Objective.

Alternative A (No Action)

The No Action alternative would have no impact on visual resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on visual resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. The potential risk of changes affecting visual resources is assessed for five significance criteria, which are described in the PEIS. Future actions based on the Reasonably Foreseeable Development scenario could result in changes that impact visual resources.

Future geothermal development activities could involve new structures, roads, and operations that are described in the Reasonably Foreseeable Development scenario. The new structures, roads, and operations would alter the characteristic landscape and be sources of light and glare. Depending on their exact location, they could also diminish scenic views afforded individuals participating in recreation activities. These impacts would be noticeable, because they would be in areas that are relatively undeveloped and would be near areas where various recreation activities occur year-round. It is assumed the stipulations outlined in Chapter 2 of the PEIS would result in positioning new structures, roads, and operations in the landscape so the landscape appeared only slightly altered and resulted in noticeable changes remaining visually subordinate to the landscape character. It is also assumed no bridges or other structures would be constructed to connect Bell Island to the mainland. As a result, changes to visual resources based on the Reasonably Foreseeable Development scenario would result in impacts on visual resources that would be consistent with a Moderate Scenic Integrity Objective.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on visual resources; however, anticipated future actions associated with development of geothermal resources could cause such impacts. Geothermal exploration and development could result in timber harvest, site clearing, and construction of power plants, pipelines, and transmission lines. This would contribute to the degradation of scenic resources in the area already occurring as a result of the intertie project.

11.3.14 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

Setting

The lease area covers approximately 7,680 acres on and adjacent to Bell Island, Alaska. Prince of Wales-Outer Ketchikan Census Area was selected as the ROI for socioeconomic analysis as the impacts of leasing are likely to occur within this region. A summary of the population, housing, employment, local school data and low-income and minority populations for Prince of Wales-Outer Ketchikan Census Area is provided based on data from Census 1990 and 2000 population, demographic and housing information (US Census Bureau 1990, 2000).

Population

In 2006, population in Prince of Wales-Outer Ketchikan Census Area was estimated at 5,688 for the 7,410.62-square-mile census area (US Census Bureau 2008). This is a 7.6 percent population reduction from 1990, when the total population within the census area was 6,146. Between 1990 and 2000 population decreased by approximately 2 percent. Population density in this census area is very low, at approximately 0.8 people per square mile in 2000. The entire census area is rural. Current trends of population reduction are expected to continue for this census area (US Census Bureau 1990, 2000).

Housing

In 2000, there were 3,055 total housing units, 2,262 of which were occupied and 1,579 of which were owner occupied. Homeowner occupancy rate was 3.7 percent and rental occupancy rate was 11.3 percent. In 1990, there were 2,543 total housing units, of which 2,061 units were occupied and 1,247 were owner occupied. Homeowner occupancy rate was 3.3 percent and the rental occupancy rate was 9.5 percent. Occupancy rates for the census area are higher than the state average; in 2000, the homeowner occupancy rate for the state of Alaska was 1.9 percent and the rental occupancy rate was 7.8 percent (US Census Bureau 1990, 2000).

Employment

In 2000 the workforce consisted of 3,075 individuals, of which 461 people or 15 percent were unemployed. This unemployment rate has remained fairly stable; in 1990, when the workforce consisted of 3,077 people, 457 or 15 percent were unemployed. This rate is higher than the state-wide rate of 9.4 percent unemployment. Due to a high degree of seasonal employment in the census area, census unemployment rates may not accurately reflect the unemployment rate in the area; labor statistics by month show an unemployment rate as high as 21 percent in the winter months (Alaska Department of Labor 2008).

Median household income in 2000 was $40,636, an increase over the 1990 median income of $39,495. The census area remains lower than the state wide median income of $51,571. Based on 2000 data, the industries employing the greatest percent of the population include educational, health and social services (20.9 percent); agriculture, forestry, fishing and hunting and mining (19.4 percent); retail trade (11.8 percent) and construction (10 percent) (US Census Bureau 1990, 2000).

Schools and Public Infrastructure

In 1990, 1,317 students were enrolled in K-12 education in the census area. In 2000 this number increased slightly to 1,473 students (US Census Bureau 1990, 2000). Student population is expected to follow local population trends.

Environmental Justice

The only minority present in significant amounts in the census area is American Indians or Alaskan Natives, which comprised approximately 38.7 percent of the population in the most recent data. Whites of non-Hispanic origin comprised 53.1 percent of the population and people of Hispanic or Latino origin comprised 1.7 percent of the population (US Census Bureau 1990, 2000). Details are provided in Table 11.3-3, below.

Table 11.3-3
Population Percentage by Race/Ethnicity in
Prince of Wales-Outer Ketchikan Census Area

	1990	2000	Percent Change
Total Population	6,278	6,146	-2.1
White	3,859	3,265	- 15.3
Black/African American	9	9	0
American Indian/Alaskan Native	2,358	2,377	+ .8
Asian	28	22	-21
Pacific Islander*	N/A	3	N/A
Other	24	31	+ 29
Two or more*	N/A	439	N/A
Hispanic or Latino**	121	107	-11.6

Source: US Census Bureau 1990, 2000.
* Not reported on1990 census: Asian and Pacific Islanders were one group and more than one race was not an option.
** In combination with other race. Totals may add to more than 100 percent as individuals can report more than one race.

In 1999, 736 people (or 12.1 percent of the population) were living below the poverty level. This number is an increase over 1990 data in which approximately 570 individuals or 9 percent of the population surveyed was living below poverty level (US Census Bureau 1990, 2000).

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on existing socioeconomics in Prince of Wales-Outer Ketchikan Census Area. No impacts would occur to minority or low income populations.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on socioeconomics or environmental justice; however, geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Impacts include a potential increase in jobs and decrease in unemployment in Prince of Wales-Outer Ketchikan Census Area due to construction and operations and maintenance jobs at a newly developed geothermal plant. Some population influx may occur to provide construction employment. The degree to which population influx will impact local schools or public infrastructure depends on the level of geothermal development.

Geothermal development would also be a positive stimulus to the local economy through increased tax revenues at the borough and state levels.

The Reasonably Foreseeable Development scenario predicts one plant of 20 MW is likely to be developed in the lease area. Impacts for a typical 50 MW plant development are discussed in Section 4 of the PEIS, Socioeconomics and Environmental Justice. Due to the rate of unemployment of 15 percent in the local area it is likely that many jobs may be filled by local census area residents, limiting the need for outside workers. As the population is currently dispersed, some temporary housing may be required near the lease site in the construction phase.

Impacts on the Native American/Native Alaskan individuals are possible as this group has a significant presence in the census area. However, negative impacts should be minimal as there are no residential areas in or adjacent to the lease areas.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on socioeconomics and environmental justice; however, anticipated future actions associated with development of geothermal resources could contribute to increases in employment opportunities in the region that are already expected as a result of the intertie project.

11.3.15 NOISE

Setting

Current sources of noise in the lease areas are limited to wind and wildlife. Sources of noise originating outside of the lease areas but affecting the lease areas are limited air traffic. Sensitive noise receptors are generally considered to be homes, hospitals, schools, and libraries. The only buildings or developments within half a mile of the lease area are the seaplane ramp and the Bell Island Hot Springs facility.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on noise.

Alternative B (Proposed Action)

Neither the Proposed Action nor anticipated future actions following leasing would have any impact on noise since no sensitive receptors have been identified within or adjacent to the lease areas.

Cumulative Impacts

Neither the Proposed Action nor anticipated future actions associated with development of geothermal resources following leasing would have cumulative impacts on noise in the lease area since the intertie project is not expected to generate noise once it is operational.

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SECTION 11.4 REFERENCES

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Chapter 12

El Centro Field Office

Analysis for Pending Lease Applications:

CACA 043965, CACA 046142

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SECTION 12.1
INTRODUCTION

12.1.1 INTRODUCTION

This lease-specific analysis describes the environmental effects of leasing 3,322 acres of public land in two pending lease areas within the BLM El Centro FO to private industry for the development of geothermal resources. Within the El Centro FO management area, 118,720 acres of land are identified as having geothermal resource potential (Bureau of Land Management 1999). This acreage is divided into seven separate areas: Dunes, East Brawley, East Mesa, Glamis, Heber, Salton Sea, and South Brawley. The pending lease areas analyzed in this lease-specific analysis are within the Salton Sea resource potential area.

This lease-specific analysis serves as an information resource to aid decision-makers in determining whether these lands are appropriate for leasing under BLM management policies and existing environmental regulations.

12.1.2 LOCAL REGULATORY CONSIDERATIONS

The pending lease application sites are located within Imperial County, California and are subject to state and local regulations, as described below.

California Desert Conservation Area Plan

The pending lease application sites are located within the California Desert Conservation Area (CDCA), which is managed under the CDCA Plan. Public lands within the CDCA have been classified into four multiple-use classes: C (controlled), L (limited use), M (moderate use), and I (intensive use). A fifth category of land is "Unclassified", for parcels that are meant to be managed on a case-by-case basis. The plan includes a Geology-Energy-Minerals (G-E-M) resource element, which defines the following goals for G-E-M resources:

1. Within the multiple-use management framework, assure the availability of known mineral resource lands for exploration and development.

2. Encourage the development of mineral resources in a manner which satisfies national and local needs, and provides for economically and environmentally sound exploration, extraction, and reclamation processes.
3. Develop a mineral resource inventory, G-E-M database, and professional, technical, and managerial staff knowledgeable in mineral exploration and development.

Specific objectives of the G-E-M element are:

1. To continue to recognize ways of access and opportunities for exploration and development on public lands assessed to have potential for critical mineral resources, minerals of national defense importance, minerals of which the U.S. imports 50 percent or more, and minerals of which the U.S. is a net exporter.
2. To continue to recognize ways of access and opportunities for exploration and development on public lands assessed to have potential for energy mineral resources. These are geothermal, oil, gas, uranium, and thorium, considered to be paramount priorities both nationally and within the State of California.

State of California Renewable Portfolio Standard Program

The California Renewable Portfolio Standard Program is a California law that requires investor-owned utilities to obtain 20 percent of the power supplied to customers to be generated from renewable resources by 2010. Geothermal energy is included in the definition of renewable resources under this program.

State Implementation Plan for PM10 in the Imperial Valley, Executive Summary, Final (1993)

The pending lease application sites fall within the Salton Sea Air Basin, which is classified as a nonattainment area for inhalable particulate matter with a diameter less than 10 micrometers (PM_{10}), based on Federal Clean Air Act standards. This lease-specific analysis will consider the impact (if any) that geothermal leasing and any potential subsequent development would have on the State of California Air Quality Implementation Plan.

Imperial County General Plan (2003)

Growth within Imperial County is directed by the Imperial County General Plan. Geothermal energy development is addressed in one of the Plan's nine elements, *Geothermal and Transmission Element*. Imperial County has no direct land-use jurisdiction over public lands; therefore, neither the General Plan nor the Imperial County zoning regulations are directly applicable to activities proposed on public lands.

California State Protocol Regarding the Manner in which the BLM will Meet its Responsibilities under the National Historic Preservation Act and the National Protocol Agreement Among the BLM, Advisory Council on Historic Preservation, and National Conference of State Historic Preservation Officers (Rev. 2007)

The BLM has developed a National Protocol Agreement (PA) that governs the manner in which the BLM shall meet its responsibilities under the National Historic Preservation Act (NHPA). This revised State Protocol Agreement was developed pursuant to provisions of the National PA and revises the provisions of State PA between the California State Director of the BLM and the California State Historic Preservation Officer (SHPO), executed on October 25, 2004. This Protocol prescribes the manner in which the BLM and the SHPO cooperatively implement the National PA in California and in portions of Nevada managed by California BLM. It is intended to ensure that the BLM organizes its programs to operate efficiently and effectively in accordance with the intent and requirements of the NHPA and that the BLM integrates its historic preservation planning and management decisions with other policy and program requirements. The Protocol streamlines the NHPA Section 106 process by eliminating case-by-case consultation with the SHPO on undertakings that culminate in "no historic properties affected" (36 CFR 800.4(d)(1)) and "no adverse effect" findings (36 CFR 800.5(b)). The Protocol also requires development and management of a Historic Preservation Program (Section 110 of the NHPA) and implementation of the Program by each Field Office in partial exchange for relief from the case-by-case procedural requirements of 36 CFR 800.

12.1.3 Scope of Analysis and Approach

This lease-specific analysis incorporates by reference the programmatic analysis presented in Volume I. This lease-specific analysis examines the cluster of two pending lease application sites, describes the Reasonably Foreseeable Development scenario for this cluster, examines the existing environmental setting, and describes the potential direct, indirect, and cumulative impacts that issuing leases, and anticipated future actions following leasing, would have on the human and natural environment.

This report focuses on specific key resource concerns in the pending lease area, and incorporates by reference the impacts described in the PEIS. Decision-makers should consider both the impacts described in this lease-specific analysis, in addition to those described in the main body of the PEIS. The analysis presented here does not reiterate the details of impacts identified in the PEIS, but rather refers to them as they arise in the impact analysis for pending lease application sites addressed here. El Centro FO staff members were contacted during the preparation of this lease-specific analysis to help identify local resource concerns.

12.1.4 CUMULATIVE ACTIONS

The El Centro FO was consulted to help identify projects in the vicinity of lease areas that may cumulatively impact resources in the area.

The FO currently has three pending right-of-way applications proposing projects on public lands in the general area of the geothermal lease applications between the Salton Sea and the Chocolate Mountains Gunnery Range. Two applications are for solar energy generation facilities:

- Right-of-way application CACA-49514 from SkyGen Solar for solar energy generation facilities, located at T9S, R13E, sections 26 and 34 (920 acres). The closest portion of these sections is approximately 3.2 miles west of Section 24 of pending lease application site CACA 046142.
- Right-of-way application CACA-48273 by BIO Renewable for solar energy generation facilities, located at T11S, R15E, Section 6 (640 acres). This location is approximately 2.8 miles southeast of sections 22 and 28 of pending lease application site CACA 043965.

The third right-of-way/temporary use permit application is related to Union Pacific Railroad's ongoing construction of a second track along their Sunset Route between El Paso, Texas, and Colton, California. The majority of the construction will be confined to their existing 200-foot railroad right-of-way, but there will be some expansion onto public land outside that boundary for culverts, drainages, berms, access, staging, etc.

No other anticipated projects were identified in the vicinity of the lease areas.

SECTION 12.2
PROPOSED ACTION AND ALTERNATIVES

12.2.1 INTRODUCTION

This chapter provides the details of the proposed action, alternatives to the proposed action, and an overview of the Reasonably Foreseeable Development scenario for pending lease application sites CACA 046142 and CACA 043965.

12.2.2 PROPOSED ACTION

The proposed action is for the BLM to issue the leases to the lease applicant for the two areas within the El Centro Field Office. The 3,321.9 acres of land are spread across a 16-mile area along the eastern side of the Salton Sea, in Imperial County, California (see Figure 12-1). Lease boundaries could be adjusted in the decision to avoid unacceptable impacts on sensitive resources.

The two pending lease sites are included within an area identified in the CDCA Plan as being the Salton Sea Known Geothermal Resources Area in the California Desert Conservation Area Plan (Bureau of Land Management 1999).

CACA 046142

CACA 046142 includes 2,161.90 acres of land within four parcels, as shown in Figure 1. The four parcels are comprised of all public lands contained within:

- Township 9 South, Range 12 East, Section 2;
- Township 9 South, Range 12 East, Section 12;
- Township 9 South, Range 12 East, Section 14, northwest quarter section, and the western half of the northeast quarter section; and
- Township 9 South, Range 12 East, Section 24.

CACA 046142 lands are located 2.5 to 5.5 miles northeast of the community of Bombay Beach, largely north of Highway 111, with a portion of Section 24 located south of the highway.

C://EMPSi/GeothermalPEIS/Figures

Both lease sites are on BLM lands.

LEGEND:

Lease site boundary

El Centro Lease Locations

CACA 043965, 046142

El Centro FO

Figure 12-1

The Section 2 parcel contains a plot of land 0.66 miles long in the east-west orientation, and from 0.25 to 0.35 miles long in the north-south orientation. The parcel is completely undeveloped and ranges in elevation from 130 feet below mean sea level to 90 feet below mean sea level. The site slopes down gently to the southwest, and features two intermittent streams and a wetland. The eastern boundary of the site is defined by Hot Mineral Spa Road. Five hot springs are recorded immediately east of the site. Some of these hot springs are used for aquaculture by Pacific Aqua Farms (U.S. Marine Shrimp Farming Program 2008; Oregon Institute of Technology 2008).

In addition to Pacific Aqua Farms, two other geothermal operators are listed at nearby addresses on Hot Mineral Spa Road: Fred F. Bartlett and Oscar Bashford (Division of Oil, Gas, and Geothermal Resources 2005).

The Section 12 parcel contains a plot of land measuring one mile by one mile. The parcel is the entire Section 12, minus two eighth-sections. The parcel is completely undeveloped and ranges in elevation from 140 feet below mean sea level to 50 feet below mean sea level. The site slopes down gently to the southwest, and features four intermittent streams and at least one wetland—the USGS topographic map indicates the presence of extensive wetland on the site; however, the Fish and Wildlife Service wetland mapper indicates only a small isolated wetland. A mobile home park is located directly to the east of the southern part of Section 12. The site is bound by Hot Mineral Spa Road to the west and Mineral Road to the east. Coachella Canal Road crosses both northeast corners of the site. A mobile home community is located directly east of the southern portion of the site.

The Section 14 parcel contains a rectangular plot of land measuring 0.75 mile in the east-west direction by 0.50 mile in the north-south direction. The parcel is completely undeveloped and ranges in elevation from 180 feet below mean sea level to 150 feet below mean sea level. The site slopes down gently to the southwest, and features five intermittent streams. The closest road access to the site is from Hot Mineral Spa Road, which is approximately 230 yards from the southeastern corner of the parcel. There are no developed uses adjacent to the parcel.

The Section 24 parcel contains a one mile by one mile section of public land. The parcel is largely undeveloped except for being crossed by a highway, a railroad, and a transmission line. The site ranges from 200 feet below mean sea level to 150 feet below mean sea level. The site slopes down gently to the southwest, and features two intermittent streams. Highway 111 crosses the southeastern third of the parcel on a northwestern-southeastern direction. There are no developed uses adjacent to the parcel.

CACA 043965

CACA 043965 includes 1,160.0 acres of land within three parcels, as shown in Figure 12-1. The three parcels are comprised of all public lands contained within:

- Township 10 South, Range 14 East, Section 8;
- Township 10 South, Range 14 East, Section 22; and
- Township 10 South, Range 14 East, Section 28, northeast quarter of the southeast quarter section.

CACA 043965 lands are located 2.5 to 6 miles north of the community of Niland, and east of Highway 111.

The Section 8 parcel is an irregularly shaped plot of land measuring between 0.5 and 1 mile in the east-west direction and between 0.5 and 1 mile in the north-south direction. The parcel is completely undeveloped and ranges in elevation from 40 feet below mean sea level to 80 feet above mean sea level. The southwestern portion of the site slopes down gently to the southwest, and the north eastern portion of the site slopes in the same direction but much more steeply and with uneven topography. Two intermittent streams cross the site. Old Niland Road/English Road forms the western boundary of the site, and Coachella Canal Road runs along the site approximately 135 yards to the northeast. The only developed land use adjacent to the site is agriculture immediately to the south.

The Section 22 parcel is an irregularly shaped plot of land measuring between 0.5 and 1 mile in the east-west direction and between 0.5 and 1 mile in the north-south direction. The parcel is completely undeveloped and ranges in elevation from zero feet above mean sea level to 80 feet above mean sea level. The site slopes down gently to the southwest with some variations in topography including the shoreline of the ancient Lake Cahuilla that exists as a distinct linear drop in elevation that crosses the southwestern portion of the site. Associated with the ancient shoreline is an ancient beach from that shoreline, noted on the USGS topographic quadrangle map as "Old Beach". A wash crosses the northern portion of the site in the northeastern-southwestern direction, transitioning into an intermittent creek that leaves the western boundary of the site. The eastern portion of the site is crossed by Gas Line Road, which runs in a north-south direction. There are no developed land uses directly adjacent to the site.

The Section 28 parcel is a square-shaped plot of land measuring 0.25 mile by 0.25 mile. The parcel is undeveloped except for Wilkins Road and the Imperial Irrigation District East Highline Canal, which both cross the southwestern portion. The site ranges in elevation from 60 feet below mean sea level to 30 feet below mean sea level. The site slopes down gently to the southwest. The only developed land use adjacent to the site is agriculture immediately to the north.

12.2.3 ALTERNATIVES

Two alternatives are considered in this lease-specific analysis: Alternative A, the No Action alternative, and Alternative B, Proposed Action.

Alternative A: No Action

Under Alternative A, the BLM would deny the two pending lease applications.

Alternative B: Leasing with Stipulations

Under Alternative B, the BLM would issue the leases with the stipulations identified in Chapter 2 of the PEIS.

12.2.4 REASONABLY FORESEEABLE DEVELOPMENT SCENARIO

It is expected that each of the pending lease sites could support a binary powerplant with a 50 megawatts of capacity; therefore, the Reasonably Foreseeable Development scenario for this lease-specific analysis is two binary powerplants with a combined capacity of 100 megawatts. It is expected that each of the lease sites could support a binary powerplant with a 50 megawatts of capacity; therefore, the Reasonably Foreseeable Development scenario for this lease-specific analysis is two binary powerplants with a combined capacity of 100 megawatts. Each of the power plants would be expected to result in 25 acres of disturbance for a total disturbance of 50 acres.

Exploration activities for the two 50 megawatt plants is expected to involve approximately 12 temperature gradient holes, disturbing approximately 0.15 acre each, for a total disturbance of approximately 2 acres. Disturbance would result from the types of activities described under Chapter 2 of the PEIS under *Phase One: Geothermal Resource Exploration*.

Assuming that commercially viable resources are found within both lease areas, drilling operations and development of the site would be expected to result in a further approximately 16 acres of land disturbance (roughly 8 acres within each lease site) from the types of activities described in the Reasonably Foreseeable Development scenario of Chapter 2 of the PEIS under *Phase Two: Drilling Operations*.

Utilization, the third phase of a geothermal project, is expected to result in a further approximately 32 acres of land disturbance (roughly 16 acres at each lease site) from the types of activities described in the Reasonably Foreseeable Development scenario of Chapter 2 of the PEIS under *Phase Three: Utilization*. The length and alignment of transmission lines are not estimated here since these factors would depend upon the positioning of any power plant and the distance to the nearest electrical tie-in.

Reclamation and abandonment, the fourth phase of a geothermal project, is expected to result in temporary disturbance of all originally disturbed acres, after which, the site would graded and vegetated to pre-disturbance conditions, as described in the Reasonably Foreseeable Development scenario of Chapter 2 of the PEIS under *Phase Four: Reclamation and Abandonment*.

SECTION 12.3
AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

12.3.1 INTRODUCTION

The following resource disciplines are not addressed in this section because they are not found in the leasing areas and are not relevant to the discussion: wild horses and burros, livestock grazing, wilderness, National Scenic and Historic Trails, and special designations.

All the pending lease applications are in geologic units that would be expected to have a relatively low potential for containing vertebrate fossils or scientifically significant invertebrate or plant fossils; therefore, paleontological resources are not analyzed in detail. Paleontological mitigative procedures outline in the PEIS would be followed for all ground distributing activities. Protective measures outlined in the PEIS would be applied.

Future development of the proposed lease sites would also yield the same health and safety impacts as identified in Chapter 4 of Volume I of the PEIS and therefore is not repeated in this lease-specific analysis.

12.3.2 LAND USE AND RECREATION

Setting

This section is a discussion of the current land ownership and use within the Region of Influence (ROI) for the two pending lease sites that are part of the proposed action. The ROI is the land area within and adjacent to the potential lease sites.

Policies and Plans

It is the policy of the Department of the Interior, consistent with Section 2 of the MMPA and Sections 102(a) (7), (8) and (12) of FLPMA, to encourage the development of mineral resources, including geothermal resources, on federal lands. The Geothermal Steam Act of 1970 provides regulatory guidance for geothermal leasing by the BLM. The CDCA Plan also addresses energy development on public lands within the California Desert Conservation Area under its G-E-M elements, as detailed in Chapter 1.

The Imperial County General Plan guides development on private lands surrounding proposed lease areas. Energy production is considered a permitted use in open space and public areas under a special use permit. The general plan specifically recognizes and encourages further use and development of geothermal resources in the Salton Sea area.

Regional Setting

The geothermal pending lease areas are located on the east side of the Salton Sea, along the western foothills of the Chocolate Mountains in Imperial County. The total pending lease area covers approximately 3,321.9 acres. Lands within and adjacent to potential lease areas are owned or administered by a variety of entities, including the BLM. Public lands are administered for multiple uses including mining, livestock grazing, recreation, energy, and utility development as well as conservation of desert resources.

Adjacent land ownership is a mix of public and privately owned lands. Adjacent land contains both land developed for agricultural purposes and undeveloped areas. Additional uses are described for the areas adjacent to each pending lease site below. The nearest population centers are Bombay Beach, 2.5 to 5.5 miles southeast of CACA 046142, and Niland, 2.5 to 6 miles south of CACA 043965. Dispersed recreational use may occur throughout the pending lease areas (e.g. OHV use, hunting, hiking, mountain biking, etc.).

Pending Lease Areas

The CDCA classifies the lease sites as "Unclassified". These lands have not been placed within multiple-use classes and are intended to be managed on a case-by-case basis.

CACA 046142

CACA 046142 is completely undeveloped except for a highway, a railroad, and a transmission line which cross through Section 28. Adjacent land uses are largely undeveloped, except for a mobile home park and an unidentified industrial or commercial complex utilizing local hot springs east of Section 2 and north of Section 12.

CACA 043965

CACA 043965 is undeveloped except for a road and a canal that cross through Section 28. Adjacent lands are a mix of undeveloped and agricultural uses.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on land use and recreation because no ground-disturbing activities would be approved.

Alternative B (Proposed Action)

The Proposed Action would not cause any direct impacts on land use or recreation; however, the anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. According to the Reasonably Foreseeable Development scenario, one plant will be developed at each pending lease site for a total of 2 power plants with 100 megawatts capacity. General impacts on land use associated with a typical 50 megawatts plant are discussed in *Section 4.2. Land use, Recreation, and Special Designations* of Volume I of the PEIS. Specific to the lease area, geothermal development could impact the local mobile home park by providing an additional source of electricity for the residents if development is successful.

The Proposed Action would be consistent with the Imperial County General Plan, as well as with the CDCA Plan.

Cumulative Impacts

The proposed plant site, associated wells, pipelines, and transmission lines would not conflict with any land use designations under the Imperial County General Plan, or under the CDCA Plan. All identified cumulative actions, including the Proposed Action would comply with local land use regulations.

Cumulative impacts on recreation from the proposed action and other local development involve possible access limitations to recreation areas, scaring wildlife away, and reducing overall recreational enjoyment, such as diminishing the visual qualities of recreation areas/adjacent land.

12.3.3 Geologic Resources and Seismicity

Setting

The pending lease sites lie within the Imperial Valley portion of the Salton Trough, which encompasses the Coachella, Imperial and Mexicali valleys and extends north from the Gulf of California. The part of the trough with the lowest elevation is inundated by the Salton Sea, which has a water surface level of approximately 227 feet below mean sea level. Geologically, the structure of the trough is a result of an evolving "rift" in the earth's crust due to tectonic plate movement. The trough represents an area of “spreading”, where two plates are moving away from one another. The meeting of the two plates is at the San Andreas Fault, which runs up the center of the trough through the center of the Salton Sea. This spreading brings magma closer to the surface, heating deep groundwater and resulting in the abundant geothermal resources in the area. Nonmarine and alluvium sediments cover large portions of the trough. An unexposed succession of Tertiary- and Quaternary-age sedimentary rocks lies below the alluvial and lake bottom sediments, ranging in depth from 11,000 or greater feet at the margins to more than 20,000 feet in the central portions of the Salton Trough. Basement rock consisting of Mesozoic granite and probably Paleozoic metamorphic rocks are estimated to exist at depths between 15,000-20,000 feet. The valley is drained by an 8,360 square mile watershed, which eventually empties into the Salton Sea (City of El Centro 2004).

The pending lease sites are located along the eastern edge of the Imperial Valley, spread across a range of elevations from 200 feet below mean sea level to 80 feet above mean sea level. The shoreline of the ancient Lake Cahuilla lies at approximately 40 feet above mean sea level. Most of the pending lease areas lie below this line, in the ancient lake bed, with a small portion of the sites lying above the line, in the foothills of the Chocolate Mountains.

Due to the "spreading" discussed above, and the presence of the San Andreas Fault, the Imperial Valley is one of the most seismically active regions in the United States. Branches of the San Andreas Fault form the eastern boundary of the basin (Salton Trough). More small to moderate earthquakes have occurred in the Imperial Valley area than along any other section of the San Andreas Fault System. During the 20th Century, the Imperial Valley experienced eleven earthquakes of magnitude 6.0 or greater on the Richter Scale with the strongest being a magnitude 7.1 temblor on the Imperial Fault in 1940. The deep, sediment-filled geology of the Trough makes the area particularly susceptible to severe earthquake damage through ground shaking, liquefaction, and landslides (City of El Centro 2004).

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on geologic resources because no ground-disturbing activities would be approved, and would not put any people or structures at risk from seismic-related events.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impacts on geological resources or put people or structures at risk from seismic events; however, the geothermal development activities likely to follow leasing would potentially result in impacts related to inducing seismic events and putting people and structures at risk from seismic events.

The composition of geologic strata (bedrock and soil) determines what can be expected from an area as a result of ground shaking. The portions of the pending lease sites below the ancient shoreline of Lake Cahuilla would be more susceptible to ground shaking and liquefaction due to the large amounts of sediment-based geology in the area. Slopes are generally not steep below the ancient shoreline, and landslides and bluff failures are generally not a concern. Bluff failures and mudslides do have the potential to occur along the embankments of intermittent streams and washes. Above the ancient shoreline, topography is steeper and uneven, making this area more susceptible to landslides and bluff failures.

Prior to construction of any facilities or infrastructure, geotechnical investigations would need to be conducted to ensure that any construction can withstand strong seismic events, and that facilities would be placed within safe distances from potential landslide and bluff failure areas.

Subsidence can occur where groundwater is pumped from underground aquifers at a rate exceeding the rate that it is of replenished. Most of the geothermal development includes reinjection of the geothermal fluid after the heat is utilized. Therefore, the potential for subsidence is low.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on geologic resources and seismicity in the lease area. The cumulative effects of anticipated future actions following leasing on geologic resources and seismicity are expected to be generally minor provided that construction and operation of the proposed geothermal plants are in compliance with building codes, and state and local permit requirements.

12.3.4 ENERGY AND MINERALS

Setting

IID Energy is the local utility company providing electricity in the Imperial Valley. IID Energy provides electric power to over 140,000 customers in the Imperial Valley and parts of Riverside and San Diego counties. IID Energy controls more than 1,100 megawatts of energy derived from a diverse resource portfolio that includes its own generation, and long- and short-term power purchases (IID Energy 2008). IID Energy's service area is experiencing a seven percent annual growth rate (IID Energy 2006).

IID is a participant in the Green Path Project; a first of its kind public-private venture between IID, Citizens Energy, and the Los Angeles Department of Water and Power. The project in part seeks to find a long-term solution to reduce California dependence on imported fuel, and works toward this by creating a transmission corridor to transport renewable resources, such as geothermal, solar, and wind energy, from the Imperial Valley to the load centers throughout California (IID Energy 2006).

IID has adopted the State of California Renewable Portfolio Standard (RPS). IID's RPS aims to procure electricity from eligible renewable resources to maintain a portfolio level of a minimum 20% by 2017, consistent with the provisions of Senate Bill 1078 (IID Energy 2006).

Imperial County contains one of the potentially largest liquid-dominated geothermal resources in the world (Lawrence Berkeley National Laboratory 1997). The geothermal resources in the County are the hottest and located at relatively shallow depths. Imperial County is a national leader in the development of its geothermal resources, but development has slowed compared to earlier County projections due to high operating costs, slow growth in utility company demand, and relatively low oil prices. The County supports and encourages the development of geothermal resources in a manner compatible with the protection of agricultural and environmental resources (Imperial County 2003).

About 60 types of minerals are extracted in Imperial County, with production being focused on gold, gypsum, sand, clay and stone. Other minerals of note are manganese, silver, copper, arsenic oxide claudetite, blodite, and kyanite. Mining has generally been limited to the southern Chocolate Mountains and the Cargo Muchacho Mountains (California Division of Mines and Geology 1966), both of which are in southeastern Imperial County, at least 30 miles from the pending lease areas. Mining in the Imperial Valley is largely limited to water availability, the presence of Native American resources, special status species habitat, and other resources protected by the CDCA Plan.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on energy and mineral resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on energy or mineral resources; however, the geothermal development activities likely to follow leasing would likely result in the use of a currently unused geothermal resource and would contribute a renewable form of energy to the power grid. According to the Reasonably Foreseeable Development scenario, development of one geothermal power plant of 50 megawatts at each pending lease area for a total of 10 megawatts is likely. Impacts for a typical 50-megawatt plant are discussed in Chapter 4 of Volume I of the PEIS, *Energy and Minerals*.

Anticipated future actions following leasing could potentially contribute to local and State efforts to meet the RPS as detailed under Senate Bill 1078.

Development could prevent other energy sources from being developed or minerals from being extracted in the immediate lease area.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on energy and minerals; however, the geothermal development activities likely to follow leasing could contribute to cumulative energy and mineral impacts in the Southwest. Development of the lease sites in combination with other geothermal energy projects in the region would cumulatively improve the regionally and locally generated renewable electricity supply.

12.3.5 Soil Resources

Setting

The Natural Resources Conservation Service does not include data for soil resources in CACA 046142 on their Web Soil Survey application, but are expected to be similar to the soil resources found below the shoreline of ancient Lake Cahuilla in CACA 043965 (described below).

Soils in CACA 043965 below the shoreline of the ancient Lake Cahuilla are generally of the Niland Series, an alluvial soil series. The Niland series is a member of the sandy over clayey, mixed (calcareous), hyperthermic family of Typic Torrifluvents. Typically, Niland soils have very pale brown, stratified, gravelly sand and sand overlying pale brown, silty clay at a depth of 23 inches. They are nearly level and on basin and floodplain edges at elevations of 300 to minus 235 feet. Niland series soils formed in coarse mixed alluvium overlying fine alluvium at depths of less than 36 inches. Slopes of this soil type are usually less than 1 percent but range up to 5 percent. The soils are well and moderately-well drained with slow runoff. Permeability of the sandy portion is rapid and permeability of the clayey portion is slow. Niland soils are used for growing irrigated row crops, field crops, and winter vegetables. Native vegetation is a sparse growth of creosotebush and wingscale. Mesquite and salt cedar grow in these soils where they can reach ground water (Natural Resources Conservation Service 2003).

Limited soil resource data is available for the portions of the pending lease areas above the shoreline of the ancient Lake Cahuilla. The Natural Resources Conservation Service online web soil survey classifies these areas largely as "badlands". Badlands are generally defined as having very irregular topography resulting from wind and water erosion of sedimentary rock.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on soil resources because no ground-disturbing activities would be approved.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on soils; however, anticipated ground disturbance from the geothermal exploration and development activities likely to follow leasing would potentially result in impacts on erosion and soil productivity.

Overall, impacts on soil resources would be similar to impacts identified in Chapter 4 of Volume I of the PEIS for the four phases of development. Prior to construction of any facilities or infrastructure, geotechnical investigations would need to be conducted to ensure that any construction be situated on stable soils, and that erosion-prevention measures be implemented in accordance with permitting requirements. Any disturbance of greater than one acre would require a General Construction Stormwater Permit from the State Water Resources Control Board, and as part of that permit application, a Stormwater Pollution Prevention Plan would be submitted. The Plan would describe erosion-prevention measures that would be incorporated into project plans.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on soils in the lease area; however, anticipated future actions associated with development of geothermal resources could contribute to cumulative soil impacts such as erosion and compaction. These impacts are expected to be generally minor provided that construction and operation of the proposed geothermal plants and other local developments are in compliance with building codes, and state and local permit requirements.

12.3.6 WATER RESOURCES AND QUALITY

Setting

Surface Water

Both pending lease areas are in the Imperial Hydrologic Unit. Annual average precipitation is about 2.5 inches (Colorado River Regional Water Quality Control Board 1986). Surface drainage is southeastward to the Salton Sea via a series of intermittent creeks and washes. Colorado River water, imported via the All American Canal, is the predominant water supply for the region and is used for irrigation, industrial, and domestic purposes (Colorado River Regional Water Quality Control Board 2006).

From a quantity standpoint, agricultural use is the predominant beneficial use of water in the Colorado River Basin Region, with the major irrigated acreage being located in the Coachella, Imperial and Palo Verde Valleys. The use of water for municipal and industrial purposes, which is second in quantity of usage, is also located largely in these valleys and in the Joshua Tree and Dale Hydrologic Units of the Lucerne Valley Planning Area. The third major category of beneficial use, recreational use of surface waters, represents another important segment of the Region's economy (Colorado River Regional Water Quality Control Board 2006).

Ground Water

In Imperial Valley, ground water is stored in the Pleistocene sediments of the valley floor, the mesas on the west, and the East Mesa and sand hills on the east. The fine-grained lake sediments in the central portion of Imperial Valley inhibit ground water movement. Few wells have been drilled in these lake sediments because the yield is poor and the water is generally saline. The few wells in the Valley are for domestic use only. Factors that diminish ground water reserves are consumptive use, evapotranspiration, evaporation from soils where ground water is near the surface, and losses through outflow and export (Colorado River Regional Water Quality Control Board 2006).

The Colorado River Regional Water Quality Control Board defines the pending lease areas as being within the Imperial Hydrologic Unit are listed Beneficial uses for groundwater in the project area are described in the Water Quality Control Plan as being "Municipal and Domestic Supply" and "Industrial Service Supply". Industrial and Service Supply is defined as "*Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, and oil well repressurization*". Municipal and Domestic Supply is defined as "*Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply*" (Colorado River Regional Water Quality Control Board 2006).

Both pending lease areas are within the East Salton Sea Groundwater Basin, which is a sub-basin of the Imperial Hydrologic Unit. This basin underlies Chocolate Valley in southern Riverside County and northern Imperial County. The basin is bounded by nonwater-bearing rocks of the Chocolate Mountains on the north and east and by the San Andreas and Banning Mission Creek faults on the west. The Chocolate Valley is drained by the Iris and Mammoth Washes to the Salton Sea (California Department of Water Resources 2003).

Water level measurements made between 1963 and 2000 indicate a steady decline has occurred in the basin over that period. Groundwater levels range from 20 to 48 feet below the surface. Groundwater moves in a southwest direction as underflow to the Salton Sea. Total storage capacity is estimated to be 360,000 acre-feet, and natural recharge is estimated at about 200 acre-feet per year. Extractions totaled about six acre-feet in 1952. Groundwater in the basin is sodium chloride or sodium sulfate in character, with TDS content ranging from 356 mg/L to 51,632 mg/L. Groundwater in the basin is not suitable for domestic, municipal, or agricultural purposes (California Department of Water Resources 2003).

Water Supply

Water in the Imperial Valley is managed by the Imperial Irrigation District (IID) Water Department. IID facilitates the transfer of raw Colorado River water for agricultural, as well as industrial, rural-residential and municipal non-potable use in the Imperial Valley. As throughout the Southwestern United States, water rights in the Imperial Valley are complex and controversial. Under legal agreements, IID exports water to the Metropolitan Water District of Southern California and the San Diego County Water Authority. As the water needs of Southern California have increased, so have the volumes of water that IID have been required to export. To offset these losses to the Imperial Valley, IID has implemented an aggressive water conservation plan involving increasing the efficiency of irrigation practices and fallowing of agricultural fields.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on water resources and quality because no ground-disturbing activities would be approved.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on water quality; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in impacts on water quality. Overall, impacts on water resources and water quality would be similar to impacts identified in Chapter 4 of Volume I of the PEIS for the four phases of development. Indirect use geothermal projects require large amounts of water during all phases of a project from exploration through reclamation and abandonment; therefore, anticipated future actions following leasing under the Proposed Action could result in impacts on the local water supply. Either groundwater or surface waters (IID waters, agricultural waste waters, Salton Sea waters) may be sought after for project-related water needs.

The project would not interfere with the designated groundwater beneficial use of *Municipal and Domestic Supply* since it is identified as being unsuitable for such purposes. The proposed action would be consistent with the other designated groundwater beneficial use of *Industrial and Service Supply*.

Developing the geothermal resource at CACA 046142 could impact the local hot springs if the geothermal reservoir is connected to the water table aquifer. The potential for these types of adverse impacts is reduced through extensive aquifer testing, which is the basis for designing the geothermal plant and for locating, designing, and operating the extraction and injection wells. Combined with the requirement to comply with state and federal regulations that protect water quality and with limitations imposed by water rights issued by the state engineer, the impacts on water quality and the potential for depleting water resources is expected to be minimized.

Any future development of the lease sites would not interfere with the existing beneficial uses of surface water in the Colorado River Basin Region since one of those identified uses is "Industrial". The availability of sufficient surface water to support an individual project would need to be confirmed with the Imperial Irrigation District.

The high volumes of water required for geothermal power plants may pose water acquisition challenges given the supply issues in the Imperial Valley.

Mitigation
Prior to development an assessment of a particular project's estimated impact on the local groundwater basin would need to be conducted.

Cumulative Impacts
The Proposed Action would not have any cumulative impacts on water quality or quantity in the lease area; however, anticipated future actions associated with development of geothermal resources could contribute to cumulative water quality and quantity impacts in the area. Geothermal development, as with the identified potential solar energy projects and railroad work, could impact surface water quality through ground disturbance and stormwater runoff. Groundwater quality could be cumulatively impacted through onsite spills of petroleum products and other chemicals used during construction and maintenance of facilities. Lease stipulations identified in Chapter 2 and best management practices in Appendix D of the PEIS would reduce these potential cumulative impacts.

The identified potential solar energy projects and railroad work would not have the potential to require groundwater usage, so no cumulative impacts on groundwater supply would be expected. All construction projects require the use of water for dust abatement. All identified projects would require water to be brought onsite with watering trucks. Construction-related water needs would be temporary.

Ongoing use of water for geothermal power plant operation would have cumulative impacts on regional water supply.

12.3.7 AIR QUALITY AND ATMOSPHERIC VALUES

Setting

The lease area lies within the Imperial Valley, which is part of the Great Basin. The Great Basin extends from Utah to the Sierra Nevada and has no surface drainage to the ocean. It is an area of climatological extremes, with the lease area being within one of the hottest and driest parts of the State. The principal climatic features of the lease area are bright sunshine, small annual precipitation, (averaging less than three inches per year), clean, dry air, and exceptionally large daily ranges of temperature. The closest weather monitoring station to the lease site with comprehensive historical data is in Brawley. Average maximum temperatures in Brawley range from 69.5 degrees Fahrenheit in January, to 107.8 in July, with average minimum temperatures ranging from 39.3 degrees Fahrenheit in January, to 76.0 in August (Western Regional Climate Center 2007).

Imperial County is in Federal Nonattainment for PM_{10} and ozone is in Attainment for all other criteria pollutants.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on air quality and local climate because no ground-disturbing activities would be approved.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on air quality or atmospheric values; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Geothermal exploration and development activities would potentially result in impacts on criteria pollutant levels, including PM_{10} and ozone, as described in the PEIS. General impacts from the four phases of geothermal development are identified in Chapter 4 of the PEIS.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on air quality in the Imperial Valley; however, anticipated geothermal exploration and development activities likely to follow leasing could contribute to cumulative air quality impacts. Construction-related dust and diesel exhaust would be realized from the exploration and drilling operations and development phases of geothermal development, as well as all from other identified cumulative actions. These cumulative impacts would be temporary.

Cumulative air quality impacts during the utilization phase of a geothermal project would be limited to vehicle travel of operation and maintenance staff. Emissions from these vehicles would cumulatively contribute to a degradation in air quality along with similar vehicular exhaust associated with operation and maintenance of the potential solar energy facilities.

12.3.8 Vegetation

Setting

The entire Salton Sea area is very dry and hot, and vegetation occurring is well adapted to these extreme conditions. The vegetation is sparse, but plays a critical role in ecosystem function, providing cover for wildlife from the sun and predators. The pending lease areas are located within the Imperial Valley subsection of the Colorado Desert ecoregion section (US Forest Service 2008). This subsection surrounds the western and southern sides of the Salton Sea and extends south past the Mexico border. Average annual temperatures range from 70 degrees Fahrenheit (˚F) in January to 107 ˚F in July. Precipitation comes only in the form of rain and three to six inches fall annually in the area (Western Regional Climate Center 2007).

The majority of the lease area is sparsely vegetated. Gravel and larger stones make up the surface substrate in many places. Where vegetation is present the predominant natural plant communities found in the pending lease areas are the Creosote bush scrub, Allscale, Iodine Bush, Saltbush, and Agricultural/ruderal communities.

Creosote Bush Scrub

Creosote bush scrub is common in the pending lease areas (US Forest Service 2008). This plant community typically occurs on well-drained secondary soils of slopes, fans, and valleys. This habitat type is generally characterized by relatively barren ground with wide-spaced shrubs. Common plants include pure stands of creosote bush *(Larrea tridentate)* or mixed shrubs, including species of burrobush/white bursage *(Ambrosia dumosa)*, brittlebush *(Encelia farinosa)*, ocotillo *(Fouquieria splendens)*, and saltbushes *(Atriplex)* (Sawyer and Keeler-Wolf 1995). Less abundant species may include desert-holly *(Atriplex hymenelytra)*, ephedras *(Ephedra* species*)*, box-thorns *(Lycium* species*)*, prickly-pears *(Opuntia* species*)*, and indigo bush *(Psorothamnus schottii)*.

Allscale

The allscale plant community is often considered part of the saltbush scrub and is found bordering the Salton Sea and may be found within the pending lease areas, especially the northern pending lease area that borders a dry wash. This series is found in old beach soils, lake deposits, dissected alluvial fans, and rolling hills. Dominant species include allscale *(Atriplex polycarpa)* and saltbushes *(Atriplex* species*)* (Sawyer and Keeler-Wolf 1995). Other common species include saltgrass *(Distichlis spicata)*, California ephedra *(Ephedra californica)*, buckwheats *(Eriogonum* species*)*, algodones buckwheat *(Eriogonum deserticola)*, California buckwheat *(Eriogonum fasciculatum)*, cheesebush *(Hymenoclea salsola)*, paleleaf goldenbush *(Isocoma acradenia)*, bladderpod *(Isomeris arborea)*, and honey mesquite *(Prosopis glandulosa)*.

Iodine Bush Scrub

Iodine bush scrub is mainly characterized by iodine bush (*Allenrolfea occidentalis*) and occurs around the margin of the Salton Sea. Other species within this community are seepweed (*Suaeda moquinii*), pickleweed (*Salicornia subterminalis*), and alkali heath (*Frankenia salina*).

Saltbush Scrub

Saltbush scrub is common within ground depressions (US Forest Service 2008). This series is a temperate, broad-leaved, evergreen shrubland with common species that includes fourwing saltbush *(Atriplex canescens)*, shadscale *(Atriplex confertifolia)*, big saltbush *(Atriplex lentiformis)*, and allscale *(Atriplex polycarpa)* (Sawyer and Keeler-Wolf 1995).

Agricultural/Ruderal

The furthest southern pending lease areas overlap areas that were historically and intermittently used for agriculture. This is the most northern portion of an area of productive agriculture supported by an intricate system of dikes, pump stations, drains, and irrigation canals. Much of the agricultural production is alfalfa or food crops for retail sale during the winter months. The area overlapped by pending leases is dominated by agricultural weeds and volunteer and invasive species resulting from disturbance (Bureau of Reclamation 2000).

Invasive Species

Invasive species are considered by BLM to be plants that have been introduced into an environment where they did not evolve (Bureau of Land Management 1998). Invasive species can have dramatic impacts on the natural ecosystem by reducing habitat for native vegetation, as well as, altering forage and wildlife habitat. Invasive species reduce the productivity of healthy rangelands, forestlands, riparian areas, and wetlands. Eradication of these species is intensive, time consuming, and costly.

In California, it is estimated that 3 percent of plant species growing in the wild are considered invasive species. Despite this small percentage, these species occupy a much greater proportion of area (California Invasive Plant Council 2008). Known invasive species within the project area include Sahara mustard *(Brassica tournefortii)* and salt cedar *(Tamarix* species*)* (Bureau of Land Management 2003). Sahara mustard is highly invasive in the Colorado Desert, adapting to dry sandy soils and out-competing native species, particularly desert annuals (California Invasive Plant Council 2008). Salt cedar thrives in riparian areas and wetlands, but is also tolerant of arid ecosystems. Salt cedar out-competes native vegetation by consuming large quantities of groundwater and depositing salts, making the soil too dry and saline for native vegetation. The BLM El Centro FO has an active management plan to address salt cedar.

Wetlands/Riparian Areas

Freshwater forested scrub wetland is found in several locations in the southern half of the Frink NW quad and within the northern pending lease area (US Fish and Wildlife Service 2008). Traversing the northern pending lease area is a wetland area that is fed by springs and water from the upstream aquaculture farm. The area remains moist throughout much of the year and often contains pools of standing water. The area drains into the Salton Sea. These streams include the Arroyo Salada, Surprise Wash, Tule Wash, and the Tarantula Wash.

This area contains willows and salt cedar. Rush (*Juncus* spp.) as well as other wetland obligate species area present in the riparian and wetland area created in the wash. The area provided valuable wildlife habitat.

Special Status Species

There are several special status species that are known to occur or may potentially occur within the vicinity of the proposed action. Special status species include Federally-listed endangered, threatened, proposed, and candidate plant species, California State-listed endangered, threatened, and rare plant species, and BLM sensitive plant species. See Section 12.3.10 *Threatened, Endangered, and Special Status Species*, for discussion of these species.

Impacts

Potential impacts on vegetation and important habitats could occur if reasonably foreseeable future actions were to:

- Affect a plant species, habitat, or natural community recognized for ecological, scientific, recreational, or commercial importance;
- Affect a species, habitat, or natural community that is specifically recognized as biologically significant in local, state, or federal policies, statutes or regulations;
- Establish or increase of noxious weed populations;
- Destroy or extensively alter habitats or vegetation communities in such a way that would render them unfavorable to native species;
- Conflicts with BLM or US Forest Service management strategies.

Alternative A (No Action)

The No Action alternative would have no impact on vegetation because no ground-disturbing activities would be approved.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on vegetation or important habitats or communities; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in impacts associated with the elimination and degradation of habitat. Geothermal development can cause the following stressors and associated impacts on vegetation and important habitats (Table 3.9-1 of Volume I the PEIS *Potential Impacts of Vegetation and Important Habitats*, provides a break down of the likelihood for impacts to occur during each phase of geothermal development):

- *Habitat disturbance* – Site clearing, well drilling, construction of access roads and geothermal facilities, as well as maintenance and operational activities would disturb habitat which would cause mortality and injury, increased risk of invasive species, and alter water and seed dispersion, as well as wildlife use, which can further affect vegetation communities.

- *Direct Removal and Injury* – Vegetation would be cleared for roadways, vehicle staging, buildings, pipelines, and transmission lines. Activities could result in loss of soil, loss of seed bank in soil, deposition of dust, and destruction of biological soil crusts. Maintenance around project components, such as drill pads, buildings, pipelines, or other facilities would involve mowing, herbicide treatment, and other mechanical or chemical means of removal and control. This would result in a net loss of important habitats and communities throughout the planning area.
- *Invasive Vegetation* – Disturbance and access by vehicles and human foot traffic may expose areas to colonization by invasive and non-native species, making it more difficult for endemic species to reestablish in disturbed areas and threatening the continued existence of endemic species (Bureau of Land Management 2007).
- *Fire* – Increased vehicular and human traffic, operation of equipment, the use of drilling muds, and the extraction of geothermal fluids can increase the risk of fires. Vehicles, electrical lines, and smoking can all result in accidental fires. Fires destroy vegetation and can aid in the establishment of invasive species.
- *Erosion* – Site clearing, grading, construction of access roads, containment basins, site runoff and vehicle and human foot traffic cause erosion. The effects of erosion include the removal of top soil, loss of seed bank, loss of native vegetation, the establishment of invasive species, the sedimentation of streams, and flooding (which can directly result in affects to riparian vegetation and riparian habitats).
- *Exposure to Contaminant* – Vehicle fuel, hydraulic fluid, solvents, cleaners, and geothermal fluids can all be harmful to vegetation and important habitats. Accidental spills can contaminate soils and water and directly harm vegetation. Licensed herbicide use would likely be used to control vegetation around geothermal facilities and support structures. Spills of herbicides or acute exposure to herbicides can have adverse affects on non-target vegetation.

Riparian and Wetland Habitat

The riparian swale and wetland habitats within the pending lease area may be affected by activities associated with all phases of geothermal projects. The construction of roadways, buildings, and other support structures may require the conversion of wetland areas. Additionally, the extraction of geothermal fluids and the use of water for drilling can alter groundwater and regional hydrology, which can have direct effects on adjacent wetland and riparian areas. Chapter 4 of Volume I of the PEIS provides more specific detail on the impacts on riparian and wetland habitats associated with geothermal activities. Impacts on wetlands are regulated under the River and Harbors Act and Section 404 of the Clean Water Act. Permitting from the U.S. Army Corps of Engineers (Corp) will be required if future development at the site will have any impact on wetlands under Corps' jurisdiction. In addition, E.O. 11990, "Protection of Wetlands," requires all federal agencies to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. DOE implementation of this E.O. is included in 10 CFR 1022.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on vegetation in the lease areas; however, anticipated future actions associated with development of geothermal resources could contribute to cumulative impacts on vegetation. Vegetation may be removed during exploration and drilling operations and development phases of a geothermal project along with the installation of solar energy facilities and railroad work. In areas where vegetation is removed, short-term, potential infestation of invasive weed species could occur. By complying with lease stipulations and best management practices outlined in Chapter 2 and Appendix D, respectively, cumulative impacts on vegetation would be reduced.

12.3.9 FISH AND WILDLIFE

Setting

Fisheries

There are no fish-bearing waters (including springs, seeps, or slow-moving streams) within the pending lease areas because of intermittent surface water resources resulting from the sandy, mountainous, and arid environment; however, the Salton Sea which is just over a mile from the pending lease area, contains a single native fish species, desert pupfish (*Cyprinodon macularius*) and several non-native fish species. The desert pupfish is listed as endangered under the Endangered Species Act. The introduced fish species are predominantly tilapia, Gulf croaker, orangemouth corvina, and sargo and they sustain an important sport fishery and provide the food base for fish-eating birds.

Wildlife

Animal abundance and diversity are closely linked with the habitat types present, though abundance and distribution may vary by seasons. The inhospitable habitat conditions limit the number, type, diversity, and abundance of species in the pending lease area.

Desert animals are well adapted to survive under extreme environmental conditions. Many small desert mammals are able to survive without freestanding water. They have adapted to rely on metabolic water for a large proportion of their water needs. In addition, since most desert animals are active predominantly at night and during the day typically retreat to cool burrows, or seek shelter either under vegetation or in rock outcrops, in order to avoid the midday sun, this action also reduces water loss. A variety of reptiles and amphibians are likely to occur in the pending lease area, including the San Sebastian leopard frog (or lowland leopard frog; *Rana yavapaiensis*), Couch's spadefoot toad (*Scaphiopus couchi*), and the flat-tailed horned lizard (*Phrynosoma mcallii*). These species are well-adapted to extremely dry conditions in areas with sandy, well-drained soils often occupied by creosote bush. Canals, roadside ditches, ponds, and riparian grasses of the Salton Basin also provide habitat, such as that of the San Sebastian leopard frog (Jennings and Hayes 1994).

Extensive root systems of desert plants such as creosote bush provide access to subsurface openings for toads, salamanders, lizards, snakes, and small mammals. Small wildlife species may also create burrows in open areas to escape the heat or predators. For example, the flat-tailed horned lizard has been observed retreating to a burrow when daytime surface temperatures have approached 120°F (Bureau of Land Management 2003).

The BLM designated the flat tailed horned lizard as a sensitive species in 1980. The designation provides increased management attention to prevent population declines and habitat loss or degradation within the Salton Basin (Bureau of Land Management 2003). Local populations of this lizard fluctuate greatly between years and because of winter/spring precipitation and production of annuals in spring; as such, these populations are very susceptible to human activities (Bureau of Land Management 2003). The flat tailed horned lizard is further discussed below in Section 12.3.10 *Threatened and Endangered Species and Special Status Species*.

The entire Salton Basin, including the pending lease area, is home to a great diversity of migratory birds (California Resources Agency 2007). The Salton Sea is a vital link in the Pacific Flyway as birds migrate along this coastal corridor. More than 400 bird species have been recorded and approximately 100 of these species have established breeding populations at the Salton Sea (Patten et al. 2003). The Sonny Bono Salton Sea National Wildlife Refuge, near the town of Niland on the eastern shore of the Salton Sea supports the bird population and provides significant bird watching recreation opportunities. Migratory birds within the project area include: *the* Swainson's hawk (Buteo swainsoni), southwestern willow flycatcher (*Empidonax traillii extimus*), and California black rail (*Laterallus jamaicensis coturniculus*). The Salton Basin provides an important food source to migratory birds during migrations north or south.

The pending geothermal lease area does not incorporate the Salton Sea, but the proposed pending lease area is within 1.5 miles of the eastern shoreline.

Migratory bird would likely pass through the pending lease area and may use a small wetland found in the pending lease area for foraging.

Several mammals occur in the area. They include: desert pocket mice (*Perognathus* species), desert kangaroo rat (*Dipodomys deserti*), rabbits, ground squirrel, and mule deer (*Odocoileus hemionus*) which seek the protection of the heavier vegetation typically found in riparian areas. Mule deer rarely travel far from water or forage, and tend to bed down within easy walking distance of both. This species typically forages around dawn and dusk while bedding down in protected areas during mid-day. However, in the arid climates (such as the Salton Basin), mule deer may migrate in response to rainfall patterns. Coyotes (*Canis latrans*) are also common in the area.

Impacts

Potential impacts on Fish and Wildlife could occur if reasonably foreseeable future actions were to:

- Adversely affect a population by substantially reducing its numbers, causing a fish or wildlife population to drop below self sustaining levels or causing a substantial loss or disturbance to habitat (such effects could include vehicle impacts and crushing, increased predation, habitat fragmentation, or loss of seasonal habitat);
- Have a substantial adverse impact on nesting migratory birds, including raptors, as protected under the Migratory Bird Treaty Act;
- Interfere with the migration of any resident or migratory fish or wildlife species, or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites; and
- Conflict with the wildlife management strategies of the BLM or US Forest Service.

Alternative A (No Action)

The No Action alternative would have no impact on fish and wildlife because no ground-disturbing activities would be approved.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on fish and wildlife; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts, as described below. Fish and aquatic life would be at minimal risk of being affected from geothermal development on the proposed lease sites. Impacts on fish in the Salton Sea may result if hazardous materials or geothermal fluid were to be released into the watershed in quantities that would be detrimental to the species.

Terrestrial wildlife species could be displaced during the removal of habitat or development of geothermal facilities. Small ground dwelling species such as reptiles and small mammals could also be crushed by vehicular traffic and clearing activities. Fire can also cause direct mortality. Vehicles, cigarette smoking, and power lines can cause wildfires that can kill and displace animal species, especially smaller and less mobile animals. Invasive vegetation introduced during exploration and development activities can also alter wildlife habitat, making it less suitable for habitation.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on wildlife in the lease areas; however, anticipated future actions associated with development of geothermal resources could indirectly contribute to cumulative wildlife impacts. Construction activities, such as grading, digging, and the use of heavy vehicles, could result in temporarily disturbing wildlife under the Proposed Action and other cumulative actions. Habitat would also be lost under the Proposed Action and the potential solar energy projects.

12.3.10 THREATENED AND ENDANGERED SPECIES AND SPECIAL STATUS SPECIES

Setting

This section provides an overview of threatened, endangered, and special status species, and their habitats that may occur in the pending lease area. Species not expected to occur in the area are only listed in the table below, but are not discussed further.

Special status species are those identified by federal or state agencies as needing additional management considerations or protection. Federal species are those protected under the Endangered Species Act and those that are candidates or proposed for listing under the Endangered Species Act. State sensitive species are those considered sensitive by the California Department of Fish and Game. A list of Sensitive species that may occur in the pending lease area is provided below based on a search of the California Natural Diversity Database, other documents as referenced, and understanding of the local habitat. Table 12.3-1 below lists species known to occur in the greater project area and their potential to occur in the pending lease areas. There are no designated critical habitats on public land in the project area, but there is potential for the presence of desert tortoise, a threatened and endangered species.

Abrams' Spurge (Chamaesyce abramsiana) is known to occur in the scrublands of the Sonora and Mojave desert on sandy flats, between the elevations of 15 and 3000 feet above mean sea level. The pending lease area is below mean sea level and the presence of the species is low.

Table 12.3-1
Species Known to Occur in the Pending Lease Area

Scientific Name	Common Name	Status Federal[1]/State[2]/ California Native Plant Society[3]	Potential Occurence[4]
PLANTS			
Chamaesyce abramsiana	Abrams' spurge	--/--/1B.3	Low
Salvia greatae	Orocopia sage	--/--/1B.3/	Moderate
FISH			
Xyrauchen texanus	razorback sucker	FE/SE	None
Cyprinodon macularius	desert pupfish	FE/SE	None
REPTILES and AMPHIBIANS			
Gopherus agassizii	Desert tortoise	FT/ST	Low
Bufo alvarius	Colorado River toad	--/SC	None
Rana yavapaiensis	lowland (=Yavapai, San Sebastian & San Felipe) leopard frog	--/SC	None
Phrynosoma mcallii	flat-tailed horned lizard	--/SC	High
BIRDS			
Rallus longirostris yumanensis	Yuma clapper rail	FE/ST	Moderate
Empidonax traillii extimus	Southwestern Willow flycatcher	FE/SE	Moderate
Dendroica petechia brewsteri	yellow warbler	--/SC	Low
Icteria virens	yellow-breasted chat	--/SC	Low

Source: California Natural Diversity Database 2008, Bureau of Land Management 2003

1Federal status:
FE = Endangered under the Endangered Species Act

2California state status
SE =State Endangered; critically imperiled due to extreme rarity, imminent threats, and or biological factors
ST = State Threatened; Imperiled due to rarity and/or other demonstrable factors
SC = State species of concern; apparently secure, though frequently quite rare in parts of its range, especially at its periphery

3California Native Plant Society
1B.3 = Rare throughout its range, no current threats known to the species

4Potential to Occur
None = No suitable habitat exists and no records of its occurrence in the area are known.
Low = Suitable habitat is not presented, but rare occurrence may result during migration or other transient activities.
Moderate = Suitable habitat is present, but no records of its occurrence in the area are known, or suitable habitat is no longer present, however, records indicate the species has been known to occur in the area.
High = Suitable habitat exists and the species in known to occur in the area.

Orocopia sage (*Salvia greatae*) is listed by California Native Plant Society as a rare species in California (California Native Plant Society Status 1B.3). Historically, this perennial evergreen shrub occurs in Mojavean and Sonoran desert scrubs, between elevations of -100 to 2,700 feet above mean sea level. The Orocopia sage has a moderate potential of occurring in the pending lease area.

Flat-tailed horned lizard (*Phrynosoma mcallii*) is a California species of special concern, found throughout most of the Colorado Desert, from northern Coachella Valley to northeastern Baja California, Mexico. In California, the flat-tailed horned lizard was designated a sensitive species by the BLM in 1980.

In 1994, several Federal agencies, including the BLM and USFWS, signed a Memorandum of Understanding (MOU), a conservation agreement establishing a general framework for protecting the flat-tailed horned lizard. In 2003, the BLM signed the *Flat-tailed Horned Lizard Management Strategy*.

The flat-tailed horned lizard occupies areas with fine, wind-blown sand deposits, and has been recorded in several vegetative communities where this substrate occurs, such as creosote bush (*Larrea tridentata*), burro weed (*Franseria dumosa*), bur-sage, and indigo-bush (*Psorothamnus* species). The presence of flat-tailed horned lizards has been recorded within the proposed action area and throughout the surrounding area. The flat- tailed horned lizard has a high potential of occurring in the pending lease area; however, the lease sites are not within the designated flat tailed horned lizard management area.

Southwestern willow flycatcher (*Empidonax traillii extimus),* yellow warbler *(Dendroica petechia brewsteri)* and yellow-breasted chat (*Icteria virens)* can be found in riparian habitats, open woodlands, and orchards; however, breeding is restricted to riparian woodlands. Southwestern willow flycatcher has potential to occur in the willows found in the riparian areas within and near the lease areas. The yellow warbler is a fairly common spring migrant, uncommon and localized summer resident, fairly common fall migrant and a rare winter visitor.

Impacts

Potential impacts on threatened and endangered and special status species could occur if reasonably foreseeable future actions were to:

- Violation the Endangered Species Act, Migratory Bird Treaty Act, or applicable state laws; or
- Decrease a plant or wildlife species population to below self-sustaining levels.

Alternative A (No Action)
The No Action alternative would have no impact on threatened and endangered species and special status species because no ground-disturbing activities would be approved.

Alternative B (Proposed Action)
The Proposed Action would not have any direct impact on threatened and endangered and special status species; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Threatened and endangered species (including federal and state listed species and BLM special status species) could be affected as a result of 1) habitat disturbance, 2) the introduction of invasive vegetation, 3) injury or mortality, 4) erosion and runoff, 5) fugitive dust, 6) noise, 7) exposure to contaminants, and 8) interference with behavioral activities. Species most likely to be affected are the flat-tailed horned lizard and Orocopia sage.

Because of the regulatory requirements of the Endangered Species Act and various state regulations, and the requirements specified in BLM Manual 6840 Special Status Species Management and other resource-specific regulations and guidelines, appropriate survey, avoidance, and mitigation measures would be identified and implemented prior to any geothermal activities to avoid adversely affecting any sensitive species or the habitats on which they rely.

Cumulative Impacts
The Proposed Action would not have any cumulative impacts on special status species in the region; however, anticipated future actions following leasing could contribute to cumulative special status species impacts. Loss of habitat from all aspects of development is a major factor contributing to the increase in the number of species listed as threatened or endangered. Future development in the lease areas is likely; however, development would be limited to small areas and disturbance would be temporary. Cumulative impacts are not likely to adversely affect special status species in the lease area.

Roads contribute to the cumulative impacts within a region. Existing roads would be used where possible for future development; however, improvements to existing roads and construction of new roads would likely be needed. Increased usage of surrounding roads and new road construction could impact populations of flat-tailed horned lizards. They are susceptible to mortality on roadways and in development areas. Additional road construction would reduce available habitat and may crush lizards and their burrows. Habitat for the lizard is not abundant in the lease area and surrounding area. Cumulative impacts are not likely to adversely affect this species.

12.3.11 CULTURAL RESOURCES

Setting

Cultural resources are past and present expressions of human culture and history in the physical environment and include prehistoric and historic archaeological sites, structures, natural features, and biota that are considered important to a culture, subculture, or community. Cultural resources also include aspects of the physical environment that are a part of traditional lifeways and practices and are associated with community values and institutions.

As in the PEIS, discussions relevant to cultural resources in this document are found in two sections. Traditional cultural resources and traditional cultural properties are addressed in Section 12.3.12, *Tribal Interests and Traditional Cultural Resources*. Cultural resources in this section include the physical remains of prehistoric and historic cultures and activities.

Both leases in the El Centro group of leases are within the California culture region, as described in Appendix I of Volume III of the PEIS. Bean (1978) and Luomala (1978) provide an ethnographic overview of the project area within the larger California culture region. The following discussion is based primarily on those overviews and a Class I survey done in the Salton Sea area (Tetra Tech 2002). The leases are considered to be within the traditional territory of Cahuilla and Yuman-speaking groups, including the Tipai. Traditional Cahuilla territory encompassed the northern half of the Salton Sink and includes the San Jacinto, Santa Rosa, and Orocopia Mountains, the southwestern slope of the San Bernardino Mountains, and the northeastern foothills of the Palomar Mountains (Bureau of Land Management 2007; Bean 1978). The traditional territory of the Yuman-speaking groups occupied the southern half of the Salton Sink, east to the Pacific Coast, west to the western slopes of the Sand Hills, and south into modern-day Baja California and Mexico (Luomala 1978). Both groups likely occupied the specific El Centro lease areas at different times prehistorically.

The Salton Sea was formed over a two-year period from 1905 to 1907 when the Colorado River breached the dike of a man-made irrigation canal and flowed into the Imperial Valley. The Salton Sea lies within the Salton Sink, which is a topographic depression that had been filled with waters from the Colorado River several times throughout prehistory as the river had repeatedly changed its course. The ancient lake is referred to as Lake Cahuilla, and was several times larger than the existing Salton Sea. Lake Cahuilla had an area of approximately 2,100 square miles, extending 110 miles in length and approximately 34 miles in width (Tetra Tech 2002).

The traditional Cahuilla territory was situated in a favorable location for trade, being bisected by the Cocopa-Maricopa trade route and adjacent to the Santa Fe and Yuman routes. This allowed the Cahuilla to be extensively involved in trade and intermarriage between groups. Villages were usually sited in canyons or on alluvial fans near freshwater sources and subsistence resources. A trail system for hunting, gathering, and trade connected the villages. Each village was marked by petroglyphs and pictographs in the surrounding area. Occupation of villages was more or less permanent. Some individuals moved to acorn groves for several weeks during the acorn-collecting season. Large granaries were used for storage of acorns and other large quantities of food. Although hunting and gathering provided the basis of subsistence for the Cahuilla, they did practice proto-agricultural techniques growing corn, beans, squashes, and melons (Bean 1990).

Yuman groups such as the Tipai were autonomous semi-nomadic bands of clans that lived in campsites and most commonly traded with neighboring Ipais; however, like the Cahuilla, intertribal trade routes were also within the territory. Locations of campsites were selected for access to freshwater, drainage, natural protection from wind and attacks, and abundance of subsistence resources. Summer camps consisted of windbreaks or trees, particularly in Mountain oak groves. Caves fronted with rocks were also used during the summer. During the winter well-sheltered areas at low elevations were occupied and clusters of dwellings were constructed. Winter sites were located to take advantage of the surrounding landscape, typically in a sheltered foothill or valley. Winter houses were semi-excavated and constructed of a dome or gable set on the ground. Movement of the bands was seasonal following ripening plants from canyon floor to higher mountain slopes (Luomala 1990).

The majority of the lease areas are contained below the elevation contour that generally defines the shoreline of ancient Lake Cahuilla. The shoreline crosses through some of the lease areas, and portions of the lease areas exist above the shoreline. The elevation contour defining the shoreline lies at approximately 40 feet above mean sea level; however, Lake Cahuilla varied in its surface elevation throughout history. Four possible high levels of the lake were determined to exist approximately between 100 B.C. and 1530 A.D. These intermittent freshwater lake and lagoon habitats were rich sources of many resources that attracted prehistoric populations. Archaeological surveys along the western shore, opposite the lease areas, have revealed many lake-related prehistoric archaeological resources, including rock fish weirs, shell middens, fish remains, and other cultural artifacts. The archaeological resources along the eastern shoreline of the ancient lake are less studied. Obsidian Butte on the southeastern shore is an important regional quarry for prehistoric tools. Fish weirs are not common, probably due to topography (Tetra Tech 2002). Given the high density of resources along the western shore, undiscovered prehistoric cultural resources can be expected to also be present along the eastern shoreline.

Historic contact between the European populations and the Cahuilla and Tipai were initially minimal, with the exception of those baptized at local missions. As contact between the Cahuilla and Spanish increased, the Cahuilla began to adopt Spanish characteristics such as cattle grazing, wage labor, clothing, language, and religion. Some would work seasonally for the Spanish and then return to their villages; however, the Cahuilla maintained a significant amount of their autonomy throughout Spanish occupation of the area (Bean 1990). Conversely, Tipais were considered resistant to Spanish control possibly due to the sedentary lifestyle it represented. Following occupation of California by the US, settlers began to seize Tipai lands. Although reservations were established in southern California, most Tipai considered them inadequate for their economy (Luomala 1990).

Historic use of the eastern Salton Sea shore includes transportation, mineral extraction, and agriculture. Early trails and a stage route were replaced by the Southern Pacific Railroad in the 1870s. The original tracks were inundated when the sea was formed, as was a large commercial salt mine begun in 1884. Niland, to the south of the lease areas, was promoted as an agricultural center but also became an important shipping point on the rail line, which was rebuilt on higher ground. Salt mining was reestablished west of Niland in 1919 at Mullet Island and a sand and gravel mine was established in 1926. Geothermal exploration and development attempts in the vicinity of the Salton Buttes date to the late 1920s; the first commercial well came online 1964. From 1932 until the mid-1950s, wells tapping CO_2 associated with the geothermal resource were used to produce dry ice (Tetra Tech 2002).

Data on cultural resources of the proposed lease area were gathered from the Southeast Information Center (SEIC) of the California Historic Resources Information System in April 2008 (SEIC File No. 0687). The SEIC noted that the lease areas are on the recessional shoreline of Lake Cahuilla. Portions of the west bank have been listed on the National Register of Historic Places (NRHP) and sites on the east bank of the pluvial lake, where the leases areas are, tend to have very small lithic tools. Very little (less than 10-percent) of the lease areas have been previously surveyed. Most of those conducted within a one-half mile radius of the leases were conducted prior to 1990. Fifteen cultural resources have been recorded within one-half mile of CACA 046142 and 21 within one-half mile of CACA 043965.

The majority of sites in the area of CACA 043965 are prehistoric sites on the shoreline of Lake Cahuilla. Two of the sites are historic linear resources associated with water delivery systems. Additionally, one of the sites is a Native American trail. Three of the sites within one-half mile of CACA 043965, CA-IMP-7835 (P-13-8333), CA-IMP-6889, and CA-IMP-6507, are within the proposed lease areas. CA-IMP-6507 is a prehistoric site consisting of "five [cleared] circles with associated lithics and ceramics and traces of midden" (von Werlhof 1991). When re-recorded in 1991, the site was described as in good condition. CA-IMP-6889 is an isolated prehistoric lithic artifact. CA-IMP-7835H is the in-use East Highline Canal, originally constructed prior to 1914. As part of the All American Canal System (CA-IMP-7130H) the canal is eligible for the

NRHP. Four previous linear surveys, 003, 0476, 03287 and 0438, have been conducted within the lease area and together cover less than 10-percent of the lease area.

Sites in the area of Lease CACA 046142 are mostly prehistoric sites on past shorelines of Lake Cahuilla. Notably, one of the prehistoric resources is a series of house pits and associated domestic refuse along the 20-foot above mean sea level terrace. It is noted that the pits are similar to those on the west shore of Lake Cahuilla. Two of the sites within one-half mile are historic linear resources associated with water delivery systems and the Southern Pacific Railroad. Four sites, CA-IMP-802, CA-IMP-1499, CA-IMP-3209H, and CA-IMP-3424H, are within the area of CACA 046142. CA-IMP-802 and CA-IMP-1499 are described as prehistoric lithic scatters with pottery locii. CA-IMP-3209H is a historic location of freshwater and grass noted on the 1856 US General Land Office map of the area by H.S. Washburn. CA-IMP-3424H is the historic route, including bridges, of the Southern Pacific Railroad (now Union Pacific Railroad), constructed in the 1870s, as noted on the 1895 US General Land Office map by F.S. Ingalls. It has been upgraded several times since its original construction, but is still eligible for the NRHP. Four previous linear surveys, 01042, 01043, 0438, and 03287, and a portion of one block survey, 0969, have been conducted within the lease area and together cover less than 10-percent of the lease.

Consultation with federally recognized tribes that are affiliated with the lease area was initiated on September 12, 2007 to identify and assess historic properties that may be affected by the undertaking. No responses from the tribes have been received as of the date of publication, however consultation is considered on-going.

It is unknown if the BLM holds additional survey reports or documentation of other recorded sites within the public lands of the lease areas. It appears several of the sites identified through the SEIC records search have not been evaluated for the NRHP. Additionally, until consultation with local Native Americans has been completed, it is unknown if there are Native American sites or sacred sites within or adjacent to the lease areas. The presence of cultural resources within portions of the leases not previously surveyed is also possible. Table 12.3-2 summarizes available data on the cultural resources of the proposed lease areas.

Table 12.3-2
Recorded Cultural Resources in the Proposed Lease Areas

Lease CACA	Survey Coverage	NRHP-listed sites	NRHP-eligible sites	NRHP-ineligible sites	Unevaluated sites (Treated as NRHP-eligible)
043965	<10%	N/A	1	N/A	2
046142	<10%	N/A	1	N/A	3

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on cultural resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on cultural resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Completion of the Section 106 process of the National Historic Preservation Act for geothermal leasing on public lands in California is conducted in adherence to the State Protocol amendment for Geothermal leasing, which requires BLM consultation with the State Historic Preservation Office only when BLM proposes to complete less than a Class III survey of the affected (selected) lands and when informal consultation with State Historic Preservation Office staff yields consensus agreement to proceed with formal consultation by allowing for a Class I record search and Tribal consultation to be considered adequate inventory and identification methodology for the purposes of Fluid Minerals decisions at the leasing stage. The agreement requires a Class III survey of all leased lands when surface occupancy is requested. The Class I record search and tribal consultation at the time of leasing are proposed to identify any potential adverse effects on historic properties which should be considered during the earliest phases of planning.

Given the sensitivity of Lake Cahuilla shorelines, the density of unevaluated and NRHP-eligible resources, and lack of previous survey coverage within the El Centro area leases, impacts on cultural resources could occur from subsequent permitted geothermal exploration, drilling operations and development, utilization, and reclamation and abandonment through ground-disturbing activities, unauthorized actions and alterations to setting and cultural landscapes. The nature of these impacts is described in Chapter 4 of Volume I of the PEIS. Additionally, as described in Chapter 2 of Volume 1 of the PEIS, various areas of cultural resources would have No Surface Occupancy stipulations: National Landmarks, National Register Districts, NRHP-listed and -eligible sites and their associated landscapes, traditional cultural properties, Native American sacred sites, and areas with important cultural and archaeological resources. Areas of potential effect would include access roads, well pads, power plant footprints, pipeline and transmission line routes, and construction staging areas as well as the boundaries of cultural resources those facilities cross and the aspects of setting that contribute to significance. These areas of potential effect would be developed at the project-specific level, and would require inventories, evaluations, and appropriate treatments as outlined in the best management practices of Appendix D in Volume III of the PEIS. Under these cultural resources best management practices, the BLM would also conduct Section 106 consultations with the State Historic Preservation Office, Native American tribes with ties to the project area, and local historic preservation groups to identify the presence and significance of cultural resources within or adjacent to the lease area and assess the level of impact of geothermal leasing and development on those resources. Project specific impacts after leasing would be reduced by implementing these best management practices.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on cultural resources; however, anticipated future actions associated with development of geothermal resources could cause such impacts. Past ground-disturbing activities and the projects identified in Section 12.1.6, *Cumulative Projects*, undoubtedly have had and will have effects on cultural resources given the area's density of cultural resources and general lack of survey coverage. Presumably past activities would have mitigated impacts to less than significant through re-design, data recovery, or other similar methods. Any indirect effects from anticipated future actions following leasing under the Proposed Action would be mitigated to less than significant through implementation of best management practices during the permitting process.

12.3.12 Tribal Interests and Traditional Cultural Resources

Setting

Tribal interests include economic rights such as Indian trust assets, and resource uses and access guaranteed by treaty rights. Traditional cultural resources or properties include areas of cultural importance to contemporary communities, such as sacred sites or resource gathering areas. While most commonly considered in the context of Native Americans and Native Alaskans, there are traditional cultural resources associated with other ethnic or socially linked groups.

The subject lease areas are contained within the Great Basin culture region, as described broadly in the Appendix I of the PEIS.

The Lake Cahuilla area was utilized at least seasonally by many groups in Southern California, Northern Baja California and the Colorado River drainage along the border with Arizona. At contact, the area appears to have been a crossroad with tribal groups related linguistically with Takic and Numic in the north and those related linguistically with Yuman groups to the south. The decedents of many of these groups have been have been absorbed into contemporary communities and reservations outside of the lease areas. Tribal affiliations include the Cocopah, Chemehuevi, Mohave, Tipai, Ipai, Kumeyaay, Luiseno, Cahuilla, Cupeño, Serrano, Quechan and Desert Cahuilla (Tetra Tech 2002).

The closest existing reservation to the project area is that of the Torrez-Martinez tribe, located on the northwest shore of the Salton Sea. The Cahuillas and their neighboring tribes to the west claim treaty rights to a very large bloc of land in Imperial, San Diego, and Riverside Counties. The Federal government subsequently allocated only portions of that land to the tribes in the form of alternating square mile parcels, which explains the checkerboard pattern of today's Torrez-Martinez Indian Reservation. The flooding of the Salton Sea basin in 1905 resulted in the inundation of nearly half of the local reservation. There have been ongoing negotiations and payments to attempt to resolve the loss of the land base (Tetra Tech 2002).

Consultation with federally recognized tribes that are affiliated with the lease area was initiated on September 12, 2007 to identify and assess tribal concerns and traditional resources that may be affected by the undertaking. No responses from the tribes have been received as of the date of publication. However, the consultation process is considered on-going. While many traditional cultural resources are well known, some locations or resources may be privileged information that is restricted to specific practitioners or clans. For tribes, maintaining confidentiality and customs regarding traditional knowledge may take precedence over identifying and evaluating these resources, unless they are in imminent danger of damage or destruction.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on tribal interests and traditional cultural resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on tribal interests and traditional cultural resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Impacts on tribal interests and traditional cultural resources are assessed using the criteria found in Chapter 4 of Volume I the PEIS. Although no tribal interests or concerns have been identified by the consultation process, the process is considered on-going and such resources may be identified in the future by tribes. Impacts on Tribal Interests would be minimized or avoided by implementing best management practices in Appendix D of Volume III of the PEIS for each of the phases of the Reasonably Foreseeable Development scenario as described in Chapter 2 of Volume I of the PEIS.

For traditional cultural resources, completion of the Section 106 process of the National Historic Preservation Act for geothermal leasing on public lands in California is conducted in adherence to the State Protocol amendment for Geothermal leasing, which requires BLM consultation with the State Historic Preservation Office only when BLM proposes to complete less than a Class III survey of the affected (selected) lands and when informal consultation with SHPO staff yields consensus agreement to proceed with formal consultation" by allowing for a Class I record search and Tribal consultation to be considered adequate inventory and identification methodology for the purposes of Fluid

Minerals decisions at the leasing stage. The agreement requires a Class III survey of all leased lands when surface occupancy is requested. The Class I record search and tribal consultation at the time of leasing are proposed to identify any potential adverse effects to historic properties which should be considered during the earliest phases of planning.

No Traditional Cultural Resources have been identified by consulted tribes thus far, but consultation is considered on-going. Additionally, archaeological resources such as those discussed in Section 12.3.11, *Cultural Resources*, are often considered traditional resources by tribes.

Impacts on traditional cultural resources from anticipated future actions following leasing could occur through ground-disturbing activities, unauthorized actions, and alterations to setting and cultural landscapes. The nature of these impacts and mitigations are described in Chapter 4 of Volume I of the PEIS. Areas of potential effect would include access roads, well pads, power plant footprints, pipeline and transmission line routes, and construction staging areas as well as the aspects of setting that contribute to significance. These areas of potential effect would be developed at the project-specific level and would require inventories, evaluations, and appropriate treatments, as outlined in the best management practices of Appendix D in Volume III of the PEIS. Under these cultural resources best management practices, the BLM would also conduct Section 106 consultations with the State Historic Preservation Office, Native American tribes with ties to the project area, and local historic preservation groups to identify the presence and significance of cultural resources within or adjacent to the lease area and assess the level of impact of geothermal leasing and development on those resources. Project-specific impacts after leasing would be reduced by implementing these best management practices.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on tribal interests and traditional resources; however, anticipated future actions associated with development of geothermal resources could cause such impacts. Past ground-disturbing activities and the project identified in Section 12.1.6, *Cumulative Projects*, may have had and may have effects on tribal interests and traditional resources given the regional density of cultural resources and general lack of survey coverage. Presumably past activities would have mitigated impacts to less than significant through re-design, data recovery, oral histories, or other similar methods. Any effects from the anticipated future actions following leasing would be mitigated to less than significant through implementation of best management practices during the permitting process.

12.3.13 VISUAL RESOURCES

Setting

This section describes the visual resources in the region of influence, which is defined as the areas within and immediately surrounding the pending lease areas. Described below is the method for managing scenic resources and the visual landscape of the pending lease areas.

The lease areas are part of the Colorado Desert geomorphic province. Major features of the area include the Salton trough, which includes the Salton Sea and the Imperial Valley. California State Highway 111 and Coachella Canal Road are the primary travel routes along the east side of the Salton Sea and past the lease areas.

The northern lease area is between the Chocolate Mountains and the Coachella Canal to the east and the Salton Sea to the west. Most of the natural vegetation in the northern lease areas are in the washes, ravines, and gullies that cross the area and drain toward Bombay Beach on the Salton Sea. Roads of various conditions also cross the northern lease area. Adjacent to the northern lease area are sparse agricultural lands, small communities, industrial areas, and recreation sites, such as hot springs. The gently rolling terrain flows toward the Salton Sea. With the exception of adjacent roads and small communities, there are no sources of light in the northern lease area.

The southern lease area is just north of Niland and between the Coachella Canal and the Salton Sea. Most of the natural vegetation in the southern lease area is in the few washes, ravines, and gullies that cross the area and drain toward the Salton Sea. The land is relatively barren of prominent landscape features. Adjacent to the southern lease areas are sparse agricultural lands and small communities. With the exception of adjacent small communities, there are no sources of light in the southern lease areas.

The BLM's Visual Resource Management System is a tool for inventorying and managing scenic resources, as well as analyzing potential impacts on visual resources. The scenery is managed using the Visual Resource Management system, described in the PEIS. The BLM (El Centro Field Office, California Desert District, California State Office) was unable to provide VRM class information for the pending lease sites for this analysis. Based on adjacent developed land uses, for the purposes of this analysis, it is assumed that the lease sites are within the VRM Class IV. The objective of this class is to provide for management activities which require major modifications of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements.

There are no scenic highways or scenic byways within several miles of the project area (National Scenic Byways Program 2008). There are no scenic vistas in Imperial County (California Department of Transportation 2008). The existing visual environment is comprised of open space, industrial, and residential for CACA 046142, and open space and agricultural for CACA 043965. CACA 046142 is visible from Highway 111, Coachella Canal Road, and small local roads such as Mineral Spa Road. CACA 043965 is visible from Coachella Canal Road, Old Niland Road/English Road, Wilkins Road, Winslow Road, and Gas Line Road. The pending lease sites lie just below the foothills of the Chocolate Mountains to the northeast, and at the eastern edge of the wide, largely flat Imperial Valley. The Salton Sea is located downslope from the pending lease areas to the west.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on visual resources because no ground-disturbing activities would be approved.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on visual resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. The potential risk of changes affecting visual resources is assessed for five significance criteria, which are described in Section 4.17 of the PEIS. Future actions based on the reasonable development scenario could result in changes that impact visual resources.

Future geothermal development activities could involve new structures, roads, and operations that are described in the Reasonably Foreseeable Development scenario. The new structures, roads, and operations would alter the characteristic landscape and be sources of light and glare. These impacts would be noticeable, because they would be in areas that are relatively undeveloped and would be readily visible due to topography and lack of obstructions. Stipulations outlined in Chapter 2 and best management practices in Appendix D of the PEIS would minimize these impacts. It is assumed the stipulations would result in positioning new structures, roads, and operations in the landscape so they would remain visually subordinate to the characteristic landscape, and would result in landform alterations that blend in with the surrounding landscape character. Therefore, changes to visual resources based on the Reasonably Foreseeable Development scenario would result in impacts on visual resources that would be consistent with Visual Resource Management Class IV objectives.

No impacts on scenic highways, byways or vistas would result from geothermal development at either of the pending lease areas.

Cumulative Impacts
The Proposed Action would not have any cumulative impacts on visual resources; however, anticipated future actions associated with development of geothermal resources could cause such impacts. Anticipated future actions and cumulative development projects would increase the number of highly visible structures in the area. This would substantially reduce the natural undeveloped landscape of the area. As with the anticipated future actions, cumulative impacts would be noticeable because future structures would not blend with the surrounding natural landscape. Sensitive receptors in the area (mobile home owners, hikers, off-highway vehicle users, etc.) could be negatively affected.

12.3.14 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

Setting

The leasing area covers approximately 3,322 acres within Imperial County. Imperial County was selected as the ROI for socioeconomic analysis as the impacts of leasing are likely to occur within this region. A summary of the population, housing, employment, local school data and low-income and minority populations for Imperial County is provided based on data from Census 1990 and 2000 population, demographic and housing information (US Census Bureau 1990, 2000, 2008).

Population
In 2006, population in Imperial County was estimated at 160,301 (US Census Bureau 2008). This is a 12.6 percent population change from 2000, when the total population within the county was 142,361. Between 1990 and 2000 population increased by approximately 23 percent. Current trends of population growth are expected to continue in the County (US Census Bureau 1990, 2000, 2008).

Housing
In 2000, there were 43,891 total housing units, 39,384 of which were occupied and 22,975 were owner occupied, with a homeowner occupancy rate of 1.4 percent and a rental property vacancy rate of 4.9 percent. In 1990, there were 36,559 total housing units, of which 32,842 units were occupied and 18,907 were owner occupied for a homeowner occupancy rate of 1.6 percent and a rental property vacancy rate of 5.0 percent (US Census Bureau 1990, 2000).

Employment
In 2000 the workforce consisted of 50,788, of which 6,375 people or 6.2 percent were unemployed. This is a decrease in unemployment from 1990,

when the workforce consisted of 43,046 people of which 14.3 percent were unemployed. Median income was $36,024 in 2000 and $22,442 in 1990.

Based on 2000 data, the industries employing the greatest percent of the population include educational, health and social services (22 percent); retail trade (12.3 percent); agriculture (11.7 percent); and public administration (11 percent) (US Census Bureau 1990, 2000, 2008).

Schools and Public Infrastructure

In 1990, 27,796 students were enrolled in K-12 education in Imperial County. In 2000 this number increased to 36,443 students. School enrollment is likely to follow general population changes (US Census Bureau 1990, 2000, 2008).

Environmental Justice

In the most recent census data, 72.2 percent of the population in the county identified themselves as Hispanic or Latino. Caucasians of non-Hispanic decent comprised 20.2 percent of the population (US Census Bureau 2000); the percent of minorities in the county has increased in recent years while the percent of non-Hispanic Caucasians has decreased (US Census Bureau 1990, 2000). See Table 12.3-3 below for additional details of race and ethnicity of the population for Imperial County.

Table 12.3-3
Population by Race/Ethnicity in Imperial County

	1990	2000	Percent Change (%)
Total Population	109,303	142,361	+ 30 %
White	73,615	70,290	- 4.5 %
Black/African American	2,622	5,624	+ 114 %
American Indian/Alaskan Native	1,859	2,666	+ 43 %
Asian	2,135	2,836	+ 32.8 %
Pacific Islander*	N/A	119	N/A
Other	29,072	55,634	+ 91.4 %
Two or more*	N/A	5,192	N/A
Hispanic or Latino**	71,935	102,817	+ 42.9 %

Source: US Census Bureau 1990, 2000.

* Not reported on1990 census: Asian and Pacific Islanders were one group and more than one race was not an option.

** In combination with other race. Totals may add to more than 100 percent as individuals can report more than one race.

In 1999, 29,681 people, or 22.6 percent of the population were living below the poverty level in Imperial County. In 1990, approximately 25,517 individuals or 23.7 percent of the population were living below poverty level. Imperial County has a higher proportion of residents classified as low income than the state average; in 2000, approximately 14.2 percent of the population of California was classified as low income (US Census Bureau 1990, 2000, 2008).

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on existing socioeconomics or environmental justice.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on socioeconomics or environmental justice; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Impacts from anticipated future actions include a potential increase in jobs and decrease in unemployment in the Imperial County due to construction and operations and maintenance jobs at newly developed geothermal plants. Geothermal development would also be a positive stimulus to the local economy through increased tax revenues at the county and state levels.

Based on the Reasonably Foreseeable Development scenario, development of two plants of 50 megawatts each is likely in the project area. The impacts for a standard 50-megawatt plant during each stage of geothermal development are discussed in Section 4.18 of the PEIS, *Socioeconomics and Environmental Justice*.

Due to the availability of unemployed workers in the county, a large population influx is not anticipated; therefore, impacts on schools and public infrastructure would be minimal. Impacts on the Hispanic and Latino population or low-income individuals are possible as these groups have a significant presence in the county. Impacts on these groups are likely to be minimal due to the lack of residential communities immediately adjacent to the pending lease sites.

Cumulative Impacts

The overall economic effect of any future geothermal development and operation at the pending lease sites would be a minor positive stimulus to the economy of the local area. In combination with other future planned development, potential cumulative effects would be minor.

12.3.15 Noise

Setting

Current sources of noise in the pending lease areas are limited to wind, dispersed recreational use, and wildlife. Sources of noise originating outside of the pending lease areas but affecting the pending lease areas include traffic from adjacent roads, air traffic, and activity from adjacent residences and industrial facilities.

Sensitive noise receptors are generally considered to be homes, hospitals, schools, and libraries. Sensitive receptors within half of a mile of CACA 046142 include:

- Residences within and nearby at the mobile home park, just east of Section 12;
- Residences north of Section 12 and east of Section 2 along Sandstone Terrace;
- Residences west of Section 12 along an unnamed east-west aligned road that connects to Hot Mineral Spa Road; and
- A residence west of Section 12 along Hot Mineral Spa Road.

Sensitive receptors within half of a mile of CACA 043965 include:

- Residences southwest of the intersection of Wilkins Road and Old Niland Road/English Road, southwest of Section 8; and
- A residence west off of Wilkins Road, west of Section 28.

Wildlife is also considered to be a sensitive noise receptor, depending on the species present in the project area. Wildlife in the project area is discussed in Sections 12.3.9 *Fish and Wildlife*, and 12.3.10 *Threatened and Endangered Species and Special Status Species.*

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on noise because no ground-disturbing activities would be approved.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on noise; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. No sensitive receptors have been identified within the pending lease areas. Adjacent and nearby sensitive receptors would be protected from noise impacts since any projects approved by the BLM would be required to adhere to the BLM regulations, requiring that noise from a major geothermal operation shall not exceed 65 A-weighted decibels at the lease boundary. Impacts on wildlife from noise sources are discussed in Sections 12.3.9, *Fish and Wildlife*, and 12.3.10 *Threatened and Endangered Species and Special Status Species.*

Cumulative Impacts

Any future cumulative construction or operation activity that causes noise disturbance would adhere to local, state, and federal regulations; therefore no cumulative noise impacts are expected.

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Chapter 13

Modoc National Forest

Surprise Field Office

Analysis for Pending Lease Applications:

CACA 042989, CACA 043744, CACA 043745

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SECTION 13.1
INTRODUCTION

13.1.1 INTRODUCTION

This lease-specific analysis describes the environmental effects of leasing the following lands to private industry for the development of geothermal resources:

- Approximately 5,440 acres of National Forest land within the Warner Mountain Forest District of the Modoc National Forest and the Surprise FO;
- Mineral rights on a further 160 acres of private land, adjacent to the National Forest lands, but still within the Surprise FO.

This lease-specific analysis serves as an information resource to aid decision-makers in determining whether these lands are appropriate for leasing under FS and BLM management policies and existing environmental regulations.

The pending lease sites are within the Warner Mountain Ranger District of the Modoc National Forest, which is the surface management agency for the sites. Subsurface mineral rights (including leasable minerals such as geothermal) are managed by the Surprise FO, who issues leases with the consent of the FS (here, the Warner Mountain Forest District of the Modoc NF) for the lands under application in the Modoc NF.

13.1.2 LOCAL REGULATORY CONSIDERATIONS

The pending lease application sites are located within Modoc County, California and are subject to state and local regulations, as described below.

State of California Renewable Portfolio Standard Program

The California Renewable Portfolio Standard Program is a California law that requires investor-owned utilities to obtain 20 percent of the power supplied to customers to be generated from renewable resources by 2010. Geothermal energy is included in the definition of renewable resources under the program.

Modoc National Forest Land and Resources Management Plan (1991)

The Modoc NF operates under the direction of the Record of Decision (ROD) for the Modoc Forest Land and Resources Management Plan (Forest Plan) as amended (US Forest Service 2004). In addition to several site specific project amendments the Forest Plan has been amended by the Sierra Nevada Forest Plan Amendment ROD (2004).

The Modoc Forest Plan addresses leasable minerals, including geothermal, and notes that the US Geologic Survey has identified most of the Forest as prospectively valuable for geothermal resources. The Lake City-Surprise Valley area is one of the two known geothermal resource areas, and is noted as including approximately 1,880 acres of the eastern edge of the Forest. In 1981, the Regional Forester signed a Decision Notice, which allowed geothermal exploration activities within the Medicine Lake Highlands portion of the forest. The Notice authorized the issuance of federal leases with certain lease stipulations.

The stipulations in the Notice are less restrictive than those put forth in Appendix I of the Forest Plan, which call for protection of:

- Surface areas with scientific, educational value, developed recreation sites, and other facilities and improvements;
- Active bald eagle nest sites;
- Modoc, shortnose and Lost River Sucker habitat;
- Highly scenic and sensitive visual areas;
- Wildlife during critical periods;
- Wetlands;
- Permitted or leased areas;
- Watershed;
- Surface water sources; and
- Erodible soils.

Surprise Field Office Resource Management Plan and Final Environmental Impact Statement (2007)

The pending lease area is within the Surprise FO. Geothermal resources underlying the pending lease sites are managed by the Surprise FO Resource Management Plan and FEIS. The Surprise FO includes approximately 1,220,644 acres of BLM-managed surface acres in northeastern California and northwest Nevada.

The Surprise FO Resource Management Plan acknowledges that geothermal leasing is encouraged, but that activity is sporadic to nonexistent in the field office. It notes that a number of energy companies have expressed interested in the field office and have conducted low-level analyses of the geothermal potential, but none have resulted in pending lease applications. The Resource Management Plan identifies the Lake City-Surprise area as being the only known geothermal resource area within the field office and anticipates continued interest and activity in the area. The Resource Management Plan notes there is a high potential for at least one proposed geothermal production facility in the field office in the future.

Modoc County General Plan (1988)

The Modoc County General Plan identifies land use classifications, and restrictions for those classifications. The General Plan would apply to the private lands of CACA 042989.

13.1.3 Scope of Analysis and Approach

This lease-specific analysis incorporates by reference the programmatic analysis presented in Volume I to which this lease-specific analysis is incorporated. This analysis examines the cluster of three pending lease application sites, describes the RFD scenario for this cluster, examines the existing environmental setting, and describes the potential direct and indirect impacts that issuing leases, and anticipated future actions following leasing, would have on the human and natural environment.

This report focuses on specific key resource concerns in the cluster, and incorporates by reference the impacts described in the PEIS. Decision-makers should consider both the impacts described in this lease-specific analysis, in addition to those described in the main body of the PEIS. The analysis presented here does not reiterate the details of impacts identified in the PEIS, but rather refers to them as they arise in the impact analysis for pending lease application sites addressed here. Modoc National Forest staff members were contacted during the preparation of this lease-specific analysis to help identify local resource concerns.

13.1.4 Cumulative Actions

Consultation with the Modoc National Forest did not identify any projects that would cumulatively contribute to impacts within the project area.

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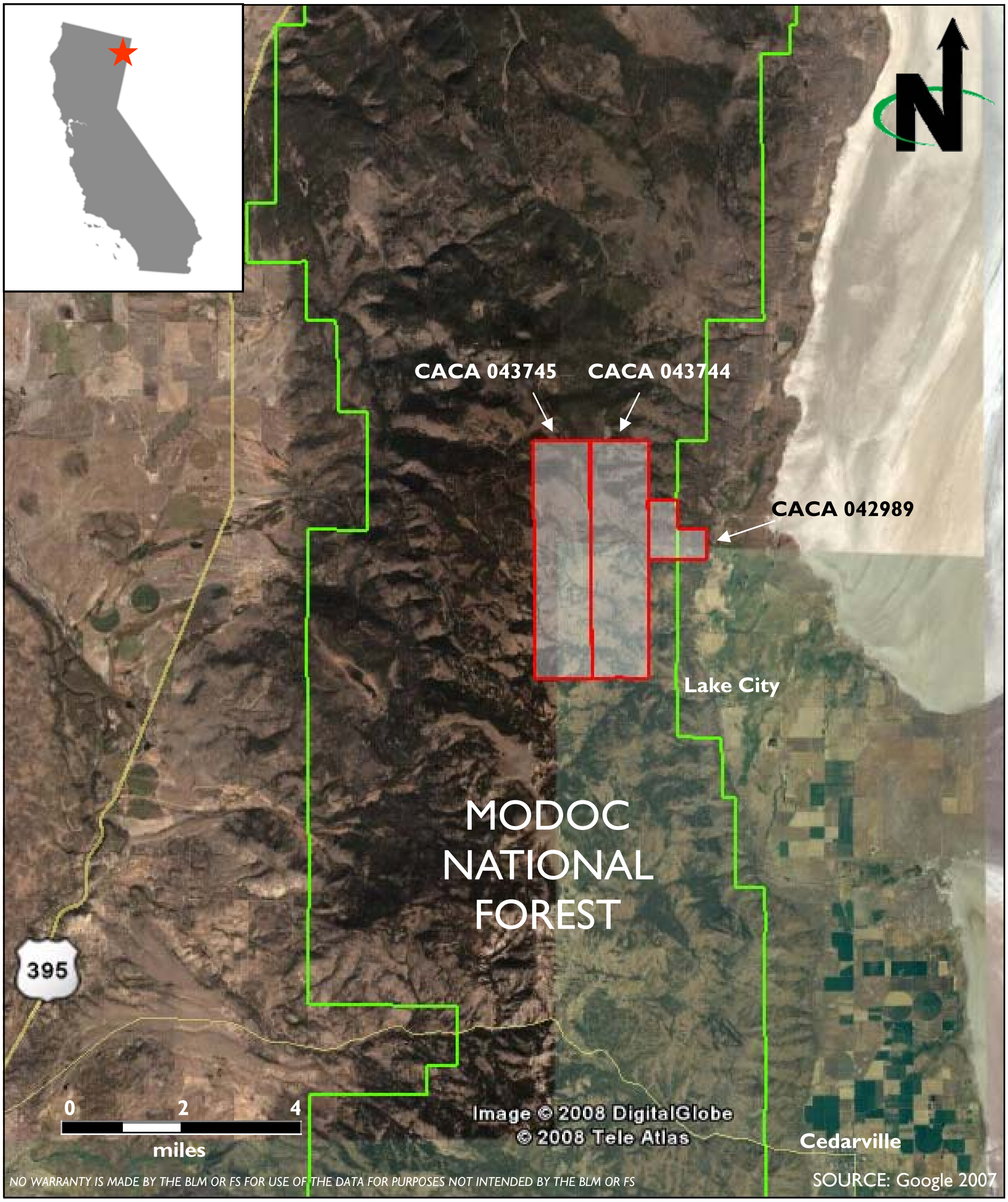
SECTION 13.2
PROPOSED ACTION AND ALTERNATIVES

13.2.1 INTRODUCTION

This chapter provides the details of the proposed action, alternatives to the proposed action, a discussion of alternatives considered but eliminated from detailed analysis, and an overview of the reasonably foreseeable develop (RFD) scenario for pending lease application sites CACA 042989, CACA 043744, and CACA 043745.

13.2.2 PROPOSED ACTION

The proposed action is for the FS to provide a consent determination to the BLM to issue the leases to the lease applicant for approximately 5,120 acres of land within the Modoc National Forest and for the BLM to issue the leases for these lands and for an additional 480 acres of private land adjacent to the Forest. The lands are all contiguous, spanning an area four miles (north to south) by three miles (east to west). The pending lease area encompasses an eastern portion of the Warner Mountains, on the western slopes of the Surprise Valley, 1.2 miles west of Lake City and approximately 8.5 miles north of Cedarville (see Figure 1). Since the pending leases are contiguous, they are discussed together as a group in detail below. Lease boundaries could be adjusted in the decision to avoid unacceptable impacts on sensitive resources.



C://EMPSi/GeothermalPEIS/Figures

All 3 lease sites are on NFS land, with a portion of CACA 042989 on private land.

LEGEND:
Lease site boundary
Modoc NF boundary

Modoc Lease Locations
CACA 042989, 043744, 043745
Modoc NF / Surprise FO

Figure 13-1

The pending lease area is comprised of three lease sites, all located within Township 44 North, Range 15 East:

- CACA 043745 - Comprised of four sections of land lying in a row, aligned in the north-south direction. As such, the proposed lease site is four miles long by one mile wide and includes 2,560 acres. The proposed lease site is completely within the Modoc NF and includes sections 9, 16, 21, and 28. This site is a focal point for several management activities including fuelwood, hunting, and range management. The site has one of the largest concentrations of both commercial and private fuelwood use. Some of the harvest areas have plantations, where use has caused tree stocking to dip below desired levels. Although hunters only utilize the area seasonally, big game hunting (definitely deer and potentially elk) is also centered in this area. Range management activities including important water sources are both within and adjacent to CACA 043745. Additional activities that have occurred or are planned for the future include prescribed burns and timber harvest. There are units from the Four Corners Sale including plantations in Compartment 312 stands 10 and 11. The area also has been identified for aspen improvement under the Bald Timber Sale. Prescribed burns have occurred in 1996 and 2003/2004 (Flores and Carlock 2008).
- CACA 043744 - Comprised of four sections of land lying in a row, aligned in the north-south direction. As such, the proposed lease site is four miles long by one mile wide and includes approximately 2,560 acres. The proposed lease site is completely within the Modoc NF and includes sections 10, 15, 22, and 27. Although some of the activities briefly described in CACA 043745 occur within this potential lease site as well, there are far fewer activities due to the lack of road access and topography. The Forest Service expects that given the nature of the landscape, steep topography, and land stability issues, development of a power plant would be a difficult undertaking (Flores and Carlock 2008).
- CACA 042989 - Comprised of three-quarters of section 14 and includes 480 acres, in an "L" shape. The potential lease site is one mile by one mile along its longest edges. The western two quarters of this the section is within the Modoc NF, and the southeastern quarter section is on private land in Modoc County. The portion of the lease site within the National Forest is accessible by foot only. The Forest Service considers the topography in the area to be unsuitable for development of facilities (Flores and Carlock 2008).

The potential lease sites are in the Warner Mountain Range at elevations ranging from 4,600 feet in the east to 7,800 at some of the mountain peaks in the central portions of the pending lease area. The eastern two sites are very steep and have unstable soils; the western site has some steep slopes, but also has areas of gentle terrain at the top of the crest. Active management by the Forest Service takes place only on the western-most portions of the pending lease area.

The pending lease area is completely undeveloped, and is traversed by a few, largely unnamed, unpaved and unmaintained roads, as well as a few trails. Several intermittent creeks are within the pending lease areas, namely Powley, Wilkinson, Boyd, and Mill creeks, as well as two headwater tributaries of the South Fork of Davis Creek. All creeks in the pending lease area drain to Surprise Valley to the east, except for the South Fork of Davis Creek, which runs to the west.

There are no developed adjacent land uses. The nearest residences are located along Surprise Valley Road, between approximately 180 and 230 yards to the east and southeast of lease application site CACA 042989. Aside from farms associated with these residences, there are no other buildings within half a mile of the proposed lease sites in any direction.

13.2.3 ALTERNATIVES

Two alternatives are considered in this lease-specific analysis: Alternative A, the No Action alternative, and Alternative B, the Proposed Action.

Alternative A: No Action

Under Alternative A, the FS would not provide a consent determination to the BLM and the BLM would not issue the three leases.

Alternative B: Proposed Action

Under Alternative B, the FS would provide a consent determination for the lease applications and the BLM would issue the leases with the stipulations identified in Chapter 2 of the PEIS.

13.2.4 REASONABLY FORESEEABLE DEVELOPMENT SCENARIO

The overall lease area is expected to result in the development of two binary power plants of 20 megawatts each. One of these plants is expected to be developed on the private lands of pending lease application site CACA 042989, and the other is expected on the northwestern portion of pending lease application site CACA 043745. No development is likely on any other portions of the sites due to all other areas being within Inventoried Roadless Areas, as well as the steep topography and land stability issues. Each of the power plants would be expected to result in 10 acres of disturbance for a total disturbance of 20 acres.

Exploration activities for the two 20-megawatt plants is expected to involve approximately 12 temperature gradient holes, disturbing approximately 0.15

acre each, for a total disturbance of approximately 2 acres. Disturbance would result from the types of activities described under Chapter 2 of the PEIS under *Phase One: Geothermal Resource Exploration*.

Assuming that commercially viable resources are found within both lease areas, drilling operations and development of the sites would be expected to result in a further approximately 6 acres of land disturbance (roughly 3 acres within each lease site) from the types of activities described in the RFD scenario of Chapter 2 of the PEIS under *Phase Two: Drilling Operations*.

Utilization, the third phase of a geothermal project, is expected to result in a further approximately 12 acres of land disturbance (roughly 6 acres at each lease site) from the types of activities described in the RFD scenario of Chapter 2 of the PEIS under *Phase Three: Utilization*. The length and alignment of transmission lines are not estimated here since these factors would depend upon the positioning of any power plant and the distance to the nearest electrical tie-in.

Reclamation and abandonment, the fourth phase of a geothermal project, is expected to result in temporary disturbance of all originally disturbed acres, after which, the site would graded and vegetated to pre-disturbance conditions, as described in the RFD scenario of Chapter 2 of the PEIS under *Phase Four: Reclamation and Abandonment*.

The pending noncompetitive lease applications for CA 043744 and 043745, which are the larger two of the three proposed lease sites and are the ones located on Forest Service land, were filed by Vulcan Power Corporation in 2001. The pending noncompetitive lease application for lease site CA 042989, the smallest of the three proposed lease sites and the one located partially on private land, was filed by Western Geothermal Partners in 2004.

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SECTION 13.3
AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

13.3.1 INTRODUCTION

The following resource disciplines are not addressed in this section because they are not found in the leasing areas and are not relevant to the discussion: wild horses and burros, wild and scenic rivers, and wilderness.

All the pending lease applications are in geologic units that would be expected to have a relatively low potential for containing vertebrate fossils or scientifically significant invertebrate or plant fossils; therefore, paleontological resources are not analyzed in detail. Paleontological mitigative procedures outline in the PEIS would be followed for all ground distributing activities. Protective measures outlined in the PEIS would be applied.

Future development of the proposed lease sites would also yield the same health and safety impacts as identified in Chapter 4 of Volume I of the PEIS and therefore is not repeated in this lease-specific analysis.

13.3.2 LAND USE, RECREATION AND SPECIAL DESIGNATIONS

Setting

This section is a discussion of the current land ownership and use within the Region of Influence (ROI) for the two proposed lease sites that are part of the proposed action. The ROI is the land area within and adjacent to the potential lease sites.

Policies and Plans

It is the policy of the Department of the Interior, consistent with Section 2 of the MMPA and Sections 102(a) (7), (8) and (12) of FLPMA, to encourage the development of mineral resources, including geothermal resources, on federal lands. The Geothermal Steam Act of 1970 provides regulatory guidance for geothermal leasing by the FS and BLM.

Local resource management plans provide direction for activities within the pending lease area. The Surprise FO Resource Management Plan follows the objectives of the Federal Government's policy for mineral resource management. Geothermal leasing and development is therefore consistent with this plan (Bureau of Land Management 2007). Forest-wide standards and guidelines are established in the Modoc Forest Plan, as amended. This Forest Plan encourages exploration and development of mineral resources provided that applicable special stipulations are applied. In addition, mineral development is subject to existing withdrawals and requires a site development and rehabilitation plan prior to use of a site (US Forest Service 1991, 2004).

Regional Setting

The proposed lease sites are in the western end of the Great Basin in the Warner Mountain Range at elevations ranging from 4,600 feet in the east to 7,800 at some central portions of the pending lease area. The total acreage of the pending lease area is approximately 5,200 contagious acres in Township 44 North, Range 15 East. Much of the area contains steep slopes, limiting the available land uses. The pending lease area is undeveloped with the exception of a few, largely unnamed, unpaved roads, as well as a few trails.

There are no developed adjacent land uses. Primary uses of the pending lease areas and adjacent land include livestock grazing, developed agriculture, forestry, mineral extraction, and recreation (US Forest Service 1991). The nearest residences are located along Surprise Valley Road, approximately between 180 and 230 yards to the east and southeast of proposed lease site CACA 942989. Aside from farms associated with these residences, there are no other buildings within half a mile of the proposed lease sites in any direction.

The nearest population center is Lake City approximately 1.4 miles to the south of pending lease CA 043744, section 27. Cedarville is approximately 10 miles south east from the same pending lease area.

There are no designated recreation areas within the pending lease area. Common recreation activities in the area include dispersed primitive camping, hiking, stream fishing, deer hunting, Nordic skiing and snowmobiling (US Forest Service 1991). A scenic byway is located to the east side of the pending leas area and a backcountry byway is on land to the west of the pending lease area.

The lands immediately adjacent to the pending lease area include NFS lands and private lands. Public land parcels are found within 2 miles to the north and south of the pending lease area and within 5 miles to the west.

Pending Lease Areas

Lands within the pending lease areas are contained within the Lake City Management Area of Modoc NF. Standards and Guidelines for this area allow for multiple uses including but not limited to semi-primitive non-motorized recreation, range, and forestry. In addition, the pending lease area is located within the Lake City–Surprise Valley geothermal potential area. Management of the geothermal resource area is within the Sierra Nevada framework amendment to the Modoc Forest Plan (US Forest Service 2004).

Large portions of the pending lease areas are contained within an Inventoried Roadless Area. Although this designation does not specifically preclude leasable mineral use, exploration for and development of leasable minerals in the roadless area would likely be limited because roads are often needed for these activities.

CACA 042989

Section 14 contains approximately 480 acres of NFS and private lands. The pending lease area consists of steep slopes and drainages containing small streams. The area under forest control is accessible by foot only, and the topography in the area is not suited for development of facilities (Flores and Carlock 2008). All NFS lands within this pending lease site are in an Inventoried Roadless Area. Since there are no existing roads within this lease site, geothermal development would not be permitted on NFS lands within CACA 042989. No developed land uses are found in the pending lease area. Only the private portion of this lease site would be likely for geothermal development. The Surprise Valley/Barrel Springs Back-Country Byway passes within approximately 200 yards of the eastern portion of the private lands portion of the lease area (Bureau of Land Management 2007).

The southeast quarter section of section 14 within CACA 042989 is located on private lands, development on which would be regulated by Modoc County. The Modoc County General Plan identifies the appropriate land use classification for geothermal powerplant operation as being "Heavy Industrial" and defines restrictions on population density, lot coverage, building height. The General Plan indicates that such land uses should be substantially removed from sensitive land uses, including residential areas, hospitals, and schools.

CACA 043744

This pending lease site is approximately four miles long by one mile wide and includes 2,560 total acres. The site is completely within the Modoc NF and includes sections 10, 15, 22, and 27. This pending lease area consists of primarily undeveloped land with moderate slopes and small drainages containing unnamed streams. Section 27 contains the only road, Lake City Canyon Road, which travels through the SW quarter section. There are no other developed uses in the pending lease area. Nearly the entire lease site is within an Inventoried Roadless Area; the only portion not without this designation is the very northwest corner and western edge of Section 10. Due to the lack of road access in Section 10, and the rugged topography along Lake City Canyon Road, it would not be feasible to construct any geothermal facilities next to existing roads; therefore, geothermal development activities would not be permitted due to the Inventoried Roadless Area (Flores and Carlock 2008).

CACA 043745

The proposed lease site is completely within the Modoc NF and includes sections 9, 16, 21, and 28 with a total of approximately 2,560 acres. Section 9 is bisected by a number of unnamed roads traveling north-south. Section 16 contains multiple natural springs in the NWNW area of the section. An unnamed road travels through the western portion of the section. Lake City Canyon Road passes though the center of the section traveling east-west. Approximately 45 percent (mostly the southern two sections) of the pending lease site portion is contained within an Inventoried Roadless Area. There are no existing roads within the Inventoried Roadless Area; therefore, no development would be permitted in this portion of the lease site. Any potential geothermal development would be restricted to the northern half of the pending lease site.

Several management activities occur in the pending lease area. The site has one of the largest concentrations of both commercial and private fuelwood use. Timber harvest and management also occurs in the area. Big game hunting for deer and elk occurs seasonally. Range management activities, including the use of water sources, occurs both within and adjacent to the pending lease area (Flores and Carlock 2008).

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on existing land uses and would not conflict with the Forest Plan, the Surprise FO Resource Management Plan, or the Modoc County General Plan.

Alternative B (Proposed Action)

The Proposed Action would have no direct impacts on land use or recreation; however, the anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. The Proposed Action would be consistent with the Forest Plan including the Sierra Nevada Forest Plan Amendment and the Surprise FO Resource Management Plan.

Based on the RFD scenario, it is estimated that a total of two power plants are likely to be developed on the site; one on the private portion of CACA 042989 and one in the CACA 043745. Approximately 10 acres are likely to be disturbed for each plant, for a total of 20 acres of disturbed land within the pending lease area. Details of the standard impacts of geothermal development on land use are discussed in Section 4.1.3 Land Use, Recreation and Special Designations of the PEIS.

There is potential that dust and noise disturbance would temporarily alter the recreation experience in and around the pending lease area, but increased roads and access into the pending lease area may also provide additional recreational opportunities. If development were to occur in the pending lease area, impacts on the visual integrity of the Surprise Valley/Barrel Springs Back-Country Byway would occur. By adhering to the stipulations identified in Appendix B of the PEIS, impacts would be reduced. Other adjacent land uses are not likely to be significantly impacted.

Impacts on Inventoried Roadless Areas
The status of pending lease land as Inventoried Roadless Areas would likely limit geothermal development in the NFS portions of pending lease site CACA 042989 (NFS land portion), all of CACA 043744 and roughly the southern and eastern portions of CACA 043745. Development in these areas would be consistent with the Inventoried Roadless Area designation as long as no new roads are constructed to access the sites. A No Surface Occupancy stipulation could be applied to all Inventoried Roadless Areas, except for corridors along existing roads, where development may be permitted.

13.3.3 GEOLOGIC RESOURCES AND SEISMICITY

Setting

The proposed lease site lies within the Great Basin area of the Basin and Range geological province. This province, characterized by steep, elongate mountain ranges alternated with long expanses of flat, dry desert, extends from eastern California to central Utah, and from southern Idaho into the state of Sonora in Mexico. Within the Basin and Range province the earth's crust and upper mantle have been stretched up to 100 percent of its original width. The entire region has been subjected to extension that thinned and cracked the crust as it pulled apart, creating large, north-south trending faults (US Geological Survey 2004).

Expansion occurs in a roughly east-southeast to west-northwesterly direction at the rate of 13 mm/yr (US Geological Survey 2008b). Beginning approximately 20 million years ago, the upthrown side of these faults began to form mountains that rise abruptly and steeply, and the down-dropped side created broad, low valleys, resulting in the provinces' distinctive alternating pattern of linear mountain ranges and valleys. The fault plane extends deep into the crust, usually at a 60 degree angle. In places, the relief or vertical difference between the two sides is as much as 10,000 feet. As the ranges rise, they are immediately subject to weathering and erosion from water, ice, wind, and other agents (US Geological Survey 2004).

The mountain ranges consist of complexly deformed late Precambrian and Paleozoic rocks and some Mesozoic granitic rocks in the western part of the province. Cenozoic volcanic rocks are widespread throughout the province. Eroded material washes down mountain side, often covering young faults until they rupture again. Sediment collects in adjacent valleys, in some places covering bedrock under thousands of feet of rock debris (US Geological Survey 2004).

In the past 150 years, there have been 14 earthquakes in the Great Basin large enough to rupture the earth's surface. Roughly 20 percent of the faults in this area have evidence of surface rupture in the past 15,000 years. Except for aftershock activity associated with some historical ruptures in the province, it is difficult to associate recorded seismicity with specific faults. There are virtually no examples of foreshock activity preceding large earthquakes. For the most part, normal faults within the Great Basin seem to be aseismic and locked, but some may be close to the point of failure (US Geological Survey 2008b).

The proposed lease sites lie near the eastern base of the Warner Mountains. The Davis Creek fault, a late-quaternary fault, dissects the mountain range, crossing within one mile of the SWSW corner of Section 28 of CACA 043745.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on geological resources, and would not put any people or structures at risk from seismic-related events.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impacts on geological resources or put people or structures at risk from seismic events; however, anticipated future actions following leasing could have impacts on related to seismicity. Development of geothermal resources at the sites would result in increased human presence on the site, and construction of facilities, infrastructure and transmission lines.

Prior to construction of any facilities or infrastructure, geotechnical investigations would be required to ensure that any construction can withstand strong seismic events.

13.3.4 ENERGY AND MINERALS

Setting

Electricity in rural Surprise Valley is provided by Pacific Power and Surprise Valley Electrification. Pacific Power is a subsidiary of PacifiCorp, which has more than 10,400 megawatts of generation capacity from coal, hydro, renewable wind power, gas-fired combustion turbines, solar and geothermal. Pacific Power serves approximately 43,850 square miles, and provides power over more than 58,000 miles of distribution lines (Pacific Power 2006).

Pacific Power generates or purchases power from four renewable energy facilities in Wyoming, Oregon, Idaho and Utah. PacifiCorp's 2007 Integrated Resource Plan calls for adding 1,400 megawatts of renewable energy to the power system in the next 10 years (PacifiCorp 2007). The IRP for Pacific Power is consistent with the State of California RPS, which aims to procure electricity from eligible renewable resources at a minimum 20% by 2017. In addition, Pacific Power operates Blue Sky Energy, a program which allows consumers to purchase wind energy in 100 kWh blocks for $1.95 per increment per block per month (Pacific Power 2006).

The 1920 Mineral Leasing Act (as amended), the 1970 Geothermal Steam Act, and 43 CFR Parts 3100 and 3200 govern oil, gas, and geothermal leasing. Oil and gas exploration is encouraged under the Surprise FO Resource Management Plan and in the Modoc Resource Management Plan. Site-specific stipulations are included in any oil and gas or geothermal environmental assessment prior to the issuance of any lease. Upon receipt of a plan of development, site-specific surveys must be completed to eliminate or mitigate any adverse impacts (Bureau of Land Management 2007).

There are no existing oil and gas leases in the pending lease area. One 7,700 acre oil and gas lease exists on the Forest and five oil and gas leases totaling approximately 28,000 acres are pending (US Forest Service 1991). The BLM has identified prospective land for oil and gas development to the east of the leasing area, but all lands are considered to have low potential (Bureau of Land Management 2007).

The Surprise FO Resource Management Plan and Final EIS identifies the Lake City area as having the greatest potential in the FO for near-term geothermal development. Current development has been limited to low-level analysis of geothermal potential and no pending lease applications have currently been filed with the BLM. Future interest and activity is anticipated in the pending lease area. There is the potential for both indirect geothermal use for power production and direct geothermal use for agricultural and recreation purposes. Existing corridors are underutilized and would provide for energy development needs (Bureau of Land Management 2007).

The pending noncompetitive lease applications for CACA 043744 and 043745 were filed by Vulcan Power Corporation in 2001. The third pending noncompetitive lease application for proposed lease site CACA 042989 was filed by Lake City Geothermal LLC. Local Modoc NF staff indicated that one or two exploratory wells had already been drilled to the east of the NFS lands by Lake City Geothermal LLC, and that there is an intention to run power lines westward across the Forest Service lands (Biggerstaff 2008).

Exploration activities continue in the area to the east and north of proposed lease site CACA 042989 in attempts to characterize the extent of the Lake City geothermal system. These efforts are centered on the Lake City Fault Zone, whose western edge, or "Range Front", is roughly in line with the eastern boundary of proposed lease site CACA 042989 (Benoit et al. 2004). Between 2002 and 2005, three core holes were drilled at the Lake City geothermal field, the deeper two of which yielded temperatures of 327 and 327 degrees Fahrenheit (Benoit et al. 2005).

Potential locatable minerals in the leasing area include mercury, gold, silver, and zeolites, perlite, pumice, and gemstones. Locatable mineral activity is primarily focused on areas of known mineral occurrences outside of the leasing area. In the Forest, mining has been confined to the Hayden Hill, Winters and High Grade mining districts. It is not anticipated that any new minerals will be found in large quantities within the Forest boundary, and mining of current mineral sources will fluctuate with the market price of the minerals (US Forest Service 1991). Saleable minerals such as sand, gravel and basalt landscaping stones have historically been sold to local communities. No gravel pits have been identified in the leasing area. On lands open to mineral development and exploration, restrictions may apply to protect natural resources and mitigate conflicts with management objectives and other land uses (US Forest Service 1991).

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on energy and mineral resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on energy or mineral resources; however, the geothermal development activities likely to follow leasing would likely result in the usage of a currently unused geothermal resource and would contribute a renewable form of energy to the power grid. Under the RFD scenario, approximately two 20 MW plants for a total of 40 MW capacity is expected in the pending lease area. Impacts for a standard 50 MW plant are discussed in *Section 4.2.3 Energy and Minerals* in the PEIS. Similar impacts are anticipated in the pending lease area at a reduced scale. Anticipated geothermal development following leasing could also potentially contribute to local and State efforts to meet the RPS as detailed under Senate Bill 1078. Geothermal development would also prevent other forms of energy or mineral development from taking place within the project footprint. All action would comply with stipulations provided by the BLM and FS plans.

13.3.5 Soil Resources

Setting

CACA 043745

This proposed site features some steep slopes with gentle terrain toward the top of the crest. Soil resources at the proposed site are a matrix of associations and gravelly, ashy loams. Paynepeak-Fendersflat south aspect association and Paynepeak gravelly ashy loam dominant the majority of the area. Both these soils derive from volcanic ash, colluvium, and residuum weathered from volcanic rock. Paynepeak-Fendersflat south aspect association has a slope of 15 to 50 percent; Paynepeak-Fendersflat gravelly ashy loam has a slope of four to 30 percent. Both soils have a depth of 40 to 60 inches, and are well drained, with no frequency of flooding, and a moderate available water capacity. The Supervisor-Cheadle families Rock outcrop association, Behanin-Cheadle families association, and Gallatin-Behanin deep-Duncom families complex soil types are found at the north end of the site. All three soil types are derived from weathered andesite, are well drained, and have very low to low available water capacity. Supervisory Cheadle families Rock outcrop association has a slope of 15 to 35 percent and a depth of more than 80 inches. The Behanin-Cheadle families association has a slope of 35 to 55 percent, with a depth of more than 80 inches. The Gallatin-Behanin deep-Duncom families complex has a slope of 35 to 60 percent, with a depth of more than 80 inches. Warnermount-Crazybird association, a soil derived from volcanic ash and rock, is found in the site's southern region. Slope for this soil type is typically 15-50 percent, with a depth of 20 to 39 inches. The soil is well drained with a low available water capacity (Natural Resources Conservation Service 2008).

CACA 043744

This proposed site features a steep and unstable matrix of gravelly loams, Paynepeak-Fendersflat associations, and Warnermount-Crazybird association. These soil types are derived from volcanic ash and colluvium. Both Paynepeak-Fendersflat cool association and Paynepeak-Fendersflat south aspect association have a slope of 15 to 50 percent, with a depth of 40 to 60 inches. These soils are well drained, with no frequency of flooding, and a moderately available water capacity. Warnermount-Crazybird association soil is found at steeper slopes, and has low available water capacity. This soil type is discussed in greater detail below (see CACA 043745). Gravelly loams found at the proposed site have an average slope of 30-50 percent, are well drained, and have very low to moderate water capacity (Natural Resources Conservation Service 2008).

CACA 042989

This proposed site features steep and unstable soils dominated by Crazybird-Warnermount association, a soil derived from volcanic ash, colluvium from pyroclastic rock, and residuum weathered from pyroclastic rock. Slope of this soil type is generally 30 to 50 percent, with a depth of 14-20 inches to paralithic bedrock. The soil is well drained, with no frequency of flooding. Water capacity is very low. Warnermount-Crazybird association, a soil derived from volcanic ash and rock, is found along the western edge of the site (see CACA 043745 for description) (Natural Resources Conservation Service 2008).

There are no prime or unique farmlands at any of the proposed lease sites (Natural Resources Conservation Service 2008).

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on soil resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on soils; however, anticipated ground disturbance from the geothermal exploration and development activities likely to follow leasing would potentially result in impacts on erosion and soil productivity. Erosion impacts would be greater in the two proposed eastern sites that contain steep slopes and unstable soils.

Prior to construction of any facilities or infrastructure, geotechnical investigations would need to be conducted to ensure that any construction be situated on stable soils, and that erosion-prevention measures be implemented in accordance with permitting requirements. Any disturbance of greater than one acre would require a General Construction Stormwater Permit from the State Water Resources Control Board, and as part of that permit application, a Stormwater Pollution Prevention Plan would be submitted. The Plan would describe erosion-prevention measures that would be incorporated into project plans. Additional mitigation may be determined at the notice of staking or the application for permit to drill stage.

13.3.6 Water Resources and Quality

Setting

Surface Water

Annual average precipitation in the lease area is about 13 inches (Western Regional Climate Center 2008). The pending lease area is within the Surprise Valley Hydrologic Unit. Water quality in this unit is managed by the Lahontan Regional Water Quality Control Board. Surface waters in the pending lease area are limited to several creeks, namely Powley, Wilkinson, Mill, and two tributaries of the South Fork of Davis Creek. Powley, Wilkinson, Mill, and Boyd creeks drain to Surprise Valley to the east, while the tributaries of South Fork of Davis Creek drain to the west.

Mill Creek is the largest of the creeks draining to Surprise Valley at Lake City. The following beneficial uses are recorded for Mill Creek:

- MUN – Municipal and Domestic Supply
- AGR – Agricultural Supply
- GWR – Groundwater Recharge
- FRSH – Freshwater Replenishment
- REC-1 – Non-contact Water Recreation
- COMM – Commercial and Sports Fishing
- COLD – Cold Freshwater Habitat
- WILD – Wildlife Habitat
- SPWN – Spawning, Reproduction and Development

Mill Creek exceeded water quality objectives set out in the Lahontan Water Quality Control Plan for Total Dissolved Solids every year from 2001 through 2005 (no data available after 2005). In 2005, for the first time, Mill Creek was measured to have dissolved oxygen levels lower than the acceptable one-day minimum, and exceeded acceptable fecal coliform levels on three sample events out of seven during the period from September 2003 through July 2005 (Lahontan Regional Water Quality Control Board 2008).

The South Fork of Davis Creek flows to the northwest into the Goose Lake Basin, and then north to Goose Lake. Water quality in the Goose Lake Basin is managed by the Central Valley Regional Water Quality Control Board. The Goose Lake Basin has been identified as a Category 1 Priority Watershed in the California Unified Watershed Assessment. The perennial streams of the Basin are reported to be degraded. Temperature and sediment are the principal water quality impairments in most of the tributaries of the Basin. Landowners and conservation groups in the area are making efforts to improve the quality of the basin's tributary streams for the variety of beneficial uses that come from these waters (Goose Lake Resource Conservation District 2002).

Ground Water

The proposed lease site lies within the Surprise Valley groundwater basin. Surprise Valley is a complexly faulted graben filled with alluvial and lacustrine sediments, and bounded on all sides by block-faulted structures. Water is stored in Holocene alluvium and alluvial fan deposits, Pleistocene near-shore deposits, and Pliocene to Pleistocene lake deposits. The basin is approximately 50 miles long and 12 miles wide, and closed with no hydrologic outlet. Most of the streams draining into Surprise Valley originate along the eastern slopes of the Warner Mountains and empty into the Upper, Middle, and Lower Alkali lakes. These lakes are shallow, alkaline, and usually become dry in summer months. Annual precipitation in the basin ranges from 13-17 inches, increasing in the north. While groundwater level trends are unknown, groundwater storage capacity to a depth of 400 feet is estimated to be approximately four million acre-feet. Natural recharge to the basin is from infiltration of surface water into alluvial fans at the base of the Warner Mountains. In the extreme northern portion of the valley, surface water from the north infiltrates coarse stream deposits and recharges underlying groundwater bodies. No true upland recharge areas exist along the western and northern sides of the valley (California Department of Water Resources 2003).

Poor water quality is present in areas near Upper and Middle Alkali lakes due to high levels of alkaline compounds and dissolved solids. Most wells in the area are used for irrigation purposes (California Department of Water Resources 2003).

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on water resources and quality.

Alternative B (Proposed Action)

Surface Waters

The Proposed Action would not have any direct impact on surface water quality or quantity; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Mill Creek can be considered an impaired water body in terms of total dissolved solids and fecal coliforms, and could be further degraded by any stormwater runoff generated by development activities within the southern portions of proposed lease sites CACA 043744 and 043745. Water quality in the tributaries of Davis Creek in the northern portion of CACA 043745 could also be negatively affected by ground disturbance.

Lease stipulations addressing stormwater are included in Appendix B of the PEIS and would reduce impacts on surface water quality. Additionally, any disturbance of greater than one acre would require a General Construction Stormwater Permit from the State Water Resources Control Board, and as part of that permit application, a Stormwater Pollution Prevention Plan would be submitted. The Plan would describe erosion-prevention measures that would be incorporated into project plans to reduce polluted stormwater from affecting nearby waterways.

Groundwater

The Proposed Action would not have any direct impact on groundwater; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. General impacts on groundwater are described in Chapter 4 of the PEIS. Groundwater resources are not reported to be currently impaired or insufficient to meet local needs. No impacts on groundwater quantity or quality would be expected; however impacts could occur if the geothermal reservoir is connected to the water table aquifer.

13.3.7 AIR QUALITY AND ATMOSPHERIC VALUES

Setting

The pending lease area is located in Modoc County, an area with air quality status of Unclassified. Due to the remote location of the proposed lease sites, air quality is considered to be good.

The lease area lies within the Great Basin. The Great Basin extends from Utah to the Sierra Nevada and has no surface drainage to the ocean. It is an area of climatological extremes. The principal climatic features of the lease area are bright sunshine, small annual precipitation, (averaging 13 inches per year), clean, dry air, and exceptionally large daily ranges of temperature. The closest weather monitoring station to the lease site is in Cedarville. Average maximum temperatures in Cedarville range from 39.9 degrees Fahrenheit in January, to 87.3 in July, with average minimum temperatures ranging from 20.4 degrees Fahrenheit in January, to 54.8 in July (Western Regional Climate Center 2008).

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on air quality or atmospheric values.

Alternative B (Proposed Action)

The Proposed Action alternative would not have any direct impact on air quality or atmospheric values. Anticipated geothermal exploration and development activities likely to follow leasing would not result in violations of ambient air quality standards given the Unclassified status of the county and the good air quality of the area; however, such anticipated actions could result in minor air quality impacts from dust and diesel exhaust during construction, and well testing, venting and blowouts during exploration and utilization.

13.3.8 VEGETATION

Setting

There are three proposed lease sites, which occur on NFS and public lands. The proposed lease sites are located within the Modoc Plateau ecological section and within the Warner Mountains subsection. Lands within the pending lease area rise from approximately 4,000 feet elevation to 7,500 feet. The natural plant communities in the pending lease area are dominated by ponderosa pine (*Pinus ponderosa*), Jeffrey pine (*Pinus Jeffreyi*), mixed conifer, and lodgepole pine (*Pinus contorta*) stands, interspersed with western juniper (*Juniper occidentalis)*, sagebrush (*Artemeisa* spp.), bitterbush (*Purshia tridentate*); and aspen (*Populus tremuloides)* and willow (*Salix* spp.) stringers in disturbed and riparian areas. Mountain meadows are also present in the lease sites, consisting of open areas covered with grasses and forbs, as well as small aspen groves. The eastern side of the pending lease area is steep and soils are unstable. The western edge of the pending lease area is more gently sloping. Activities that affect vegetation such as limited timber harvest and recreational activities (hunting, hiking, fishing) appear or have occurred within the pending lease area (Flores and Carlock 2008).

Invasive Species

Invasive species include any type of species that are not native to that ecosystem and includes plants or animals that have been introduced into an environment where they did not evolve (Bureau of Land Management 1998). Invasive species can have dramatic impacts on the natural ecosystem by reducing habitat for native vegetation as well as from altering forage and wildlife habitat. Invasive species reduce the productivity of healthy rangelands, forestlands, riparian areas, and wetlands. Eradication of these species is intensive, time consuming, and costly.

In California, it is estimated that 3 percent of plant species growing in the wild are considered invasive species. Numerous exotic grasses and plants, like perennial pepper weed *(Lepidium latifolium),* annual medusahead (*Taeniatherum caput-medusa*), red brome (*Bromus rubens*), and various non-native thistles, have displaced native plants and altered local plant communities on the Modoc Plateau (California Department of Fish and Game 2006). Cheatgrass (*Bromus tectorum*) has had a particularly dramatic impact on native shrub and grassland communities of the Great Basin and the lower elevations of the Warner Mountains. These communities are limited throughout the pending lease area, but do exist at lower elevations. Cheatgrass displaces native grasses and forbs by more effectively tapping soil moisture and hinders seedling establishment of native shrubs by reducing moisture and nutrients in surface soils (Norton et al. 2004).

Wetlands/Riparian Areas

No wetlands are found within the pending lease area (US Forest Service 2008b). Several small intermittent streams run east from the Warner Mountains to Upper Lake, passing through the north and central portion of the pending lease area. These streams include Pauly and Wilkinson Creek. Mill Creek, which passes through the southern section of the project, is a perennial stream and supports riparian vegetation as well as a seasonal trout fishery. The riparian areas are typically populated with aspens and willows. Aspen stands are in sharp decline throughout the Modoc National Forest (Di Orio et al. 2005).

Riparian Reserves

On federal lands, riparian reserves are designated to protect water quality; timber harvest is prohibited and ground disturbances are not allowed. The reserve's width is based on the presence of fish and whether the stream is permanent or intermittent.

Special Status Species

There are several special status species that are known to occur or may potentially occur within the vicinity of the pending lease area. Special status species include Federally-listed endangered, threatened, proposed, and candidate plant species, California State-listed endangered, threatened, and rare plant species, and BLM and FS sensitive plant species. See Section 3.11, Threatened and Endangered Species and Special Status Species, for discussion of these species.

Impacts

Potential impacts on vegetation and important habitats could occur if reasonably foreseeable future actions were to:

- Affect a plant species, habitat, or natural community recognized for ecological, scientific, recreational, or commercial importance;
- Affect a species, habitat, or natural community that is specifically recognized as biologically significant in local, state, or federal policies, statutes or regulations;
- Establish or increase of noxious weed populations;
- Destroy or extensively alter habitats or vegetation communities in such a way that would render them unfavorable to native species; and/or
- Conflict with BLM or FS management strategies.

Alternative A (No Action)

The No Action alternative would have no impact on vegetation or important habitats.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on vegetation or important habitats or communities; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in impacts associated with the elimination and degradation of habitat. Geothermal development can cause the following stressors which may result in associated impacts on vegetation and important habitats:

- Habitat disturbance – Site clearing, well drilling, construction of access roads and geothermal facilities, as well as maintenance and operational activities would disturb habitat which in turn could cause mortality and/or injury to plants, an increased risk of invasive species colonization, alter water and seed dispersion, as well as affect wildlife use, which can further affect vegetation communities.

- Direct Removal and Injury – Vegetation would be cleared for roadways, vehicle staging, buildings, pipelines, and transmission lines. These activities could result in loss of soil, loss of seed bank in soil, deposition of dust, and destruction of biological soil crusts. Maintenance around project components, such as drill pads, buildings, pipelines, or other facilities, would involve mowing, herbicide treatment, and other mechanical or chemical means of removal and control of plant life. This would in turn result in a net loss of important habitats and communities throughout the planning area.
- Invasive Vegetation – Disturbance and access by vehicles and human foot traffic may expose areas to colonization by invasive and non-native species, making it more difficult for endemic species to reestablish in disturbed areas as well as threatening the continued existence of endemic species (Bureau of Land Management 2007).
- Fire – Increased vehicular and human traffic, operation of equipment, the use of drilling muds, and the extraction of geothermal fluids can increase the risk of fires. Vehicles, electrical lines, and cigarette smoking can all result in accidental fires. Fires destroy vegetation and can aid in the establishment of invasive species.
- Erosion – Site clearing, grading, construction of access roads, containment basins, site runoff, and vehicle and human foot traffic cause erosion. The effects of erosion include the removal of top soil, loss of seed bank, loss of native vegetation, the establishment of invasive species, the sedimentation of streams, and flooding (which can directly result in effects to riparian vegetation and riparian habitats).
- Exposure to Contaminants – Vehicle fuel, hydraulic fluid, solvents, cleaners, and geothermal fluids can all be harmful to vegetation and important habitats. Accidental spills can contaminate soils and water and directly harm vegetation. Licensed herbicide use would likely be used to control vegetation around geothermal facilities and support structures. Spills of herbicides or acute exposure to herbicides can have adverse affects on non-target vegetation.

Table 3.9-1 in section 3.9 of the PEIS provides an analysis of the likelihood for impacts to occur during each phase of geothermal development (exploration, drilling operations, utilization, and reclamation and abandonment).

Riparian and Wetland Habitat

The riparian habitat and intermittent stream drainages, as well as Mill Creek, may be affected by activities associated with all phases of geothermal projects if development were to occur in close proximity to these habitats. Chapter 4 of the PEIS provides more specific detail on the impacts on riparian and wetland habitats associated with geothermal development activities. Wetlands are not currently present in the pending lease area, but wetland conditions are subject to change based on precipitation and other ecological and geologic events that may affect hydrology. Impacts on wetlands are regulated under the River and Harbors Act and Section 404 of the Clean Water Act. Permitting from the US Army Corps of Engineers (Corps) would be required if future development at the site would have any impact on wetlands under Corps' jurisdiction. In addition, E.O. 11990, "Protection of Wetlands," requires all federal agencies to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. DOE implementation of this E.O. is included in 10 CFR 1022.

13.3.9 FISH AND WILDLIFE

Setting

There are 399 vertebrate species that inhabit the Modoc Plateau region at some point in their life cycle, including 235 birds, 97 mammals, 23 reptiles, 6 amphibians, and 38 fish (California Department of Fish and Game 2006).

Common mammal species include mule deer (*Odocoileus hemionus*), rabbits, squirrels, porcupine (*Erethizon dorsatum*), chipmunks, coyote (*Canis latrans*), badger (*Taxidea taxus*), and bobcats *(Lynx rufus*). There are documented Sierra Nevada red fox (*Vulpes vulpes necator*) sightings in the western portion of the pending lease area. Porcupine (*Erethizon dorsatum*) and marten (*Martes americana*) may also be present in the lease area.

Bird species include various quail, dove, woodpeckers, warblers, sapsuckers, flycatchers, owls, and red-tailed hawk (*Buteo jamaicensis*). Golden eagles (*Aquila chrysaetos*), peregrine (*Falco peregrinus*), prairie falcons (*Falco mexicanus*), and northern goshawks (*Accipiter gentiles*) hunt in the pending lease area. Numerous waterfowl of the Pacific Flyway pass through and may nest in the area.

A variety of reptiles utilize the project area, including the California king snake (*Lampropeltis getula californiae*), western rattlesnake (*Crotalus oreganus)* the Pacific gopher snake (*Pituophis catenifer catenifer),* terrestrial garter snake *(Thamnophis elegans*), alligator lizard (*Elgaria coerulea),* and western skink (*Eumeces skiltonianus).* The streams in the pending lease area are predominately intermittent, with the exception of Mill Creek, and are not known to support fisheries (US Forest Service 2008b). Mill Creek supports rainbow trout from historical stocking efforts, but does not contain any special status fish species (US Environmental Protection Agency 2004, US Forest Service 2008b)

The major stressors negatively affecting terrestrial wildlife on the Modoc Plateau are a combination of livestock and feral horse grazing, invasive annual grasses, the expansion of native western juniper, and altered frequencies of fire. Together, these stressors have combined to alter the region's sagebrush and forest habitats and ecosystems (Miller et al. 1994, Schaeffer et al. 2002).

Impacts

Potential impacts on fish and wildlife species could occur if reasonably foreseeable future actions were to:

- Adversely affect a population by substantially reducing its numbers, causing a fish or wildlife population to drop below self sustaining levels, or by causing a substantial loss or disturbance to habitat utilized by a fish or wildlife population. Examples of such habitat effects could include vehicle impacts and crushing, increased predation, habitat fragmentation, or loss of seasonal habitat;
- Have a substantial adverse impact on nesting migratory birds, including migratory raptors, as protected under the Migratory Bird Treaty Act;
- Interfere with the movement of any resident or migratory fish or wildlife species, or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites; and/or
- Conflict with the wildlife management strategies of the BLM or FS.

Alternative A (No Action)

The No Action alternative would have no impact on fish and wildlife because no ground-disturbing activities would be approved.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on fish and wildlife; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts, as described below. Fish and aquatic wildlife would be at minimal risk of being affected from geothermal activities on the proposed lease sites. Mill Creek is the only year-around waterway and the steep topography in its watershed would make development unlikely. Potential impacts on waterways and fish and aquatic life would be analyzed prior to any ground-disturbing activities.

Terrestrial wildlife species could be displaced during the removal of habitat or development of geothermal facilities. Small ground dwelling species such as reptiles and small mammals could also be crushed by vehicle traffic and clearing activities. Fire can also cause direct mortality. Vehicles, cigarette smoking, and power lines can cause wildfires that can kill and displace animal species, especially smaller and less mobile animals. Invasive vegetation introduced during exploration and development activities can also alter wildlife habitat, making it less suitable for habitation.

The habitats within the pending lease area provides important habitat for a variety of resident and migratory birds. The FS and BLM area required to analyze the impacts of any action on migratory birds, under the Migratory Bird Treaty Act. The likelihood of disturbing nests of such birds is limited primarily to breeding and nesting seasons (spring and summer). Lease stipulations to avoid disturbance during the migratory bird nesting season, so as not to violate the Migratory Bird Treaty Act, would reduce the potential for significant impacts on migratory birds. Waterfowl, raptors, and small birds that depend on particular forest types as a source of food or cover could be vulnerable to loss of these habitats within the pending lease area. In addition, removing timber and other vegetative cover is likely to affect foraging and nesting behavior.

13.3.10 Threatened and Endangered Species and Special Status Species

Setting

This section provides an overview of threatened, endangered, and special status species, and their habitats that may occur in the pending lease area. Special status species are those identified by federal or state agencies as needing additional management considerations or protection. Federal species are those protected under the Endangered Species Act and those that are candidates or proposed for listing under the Endangered Species Act. State sensitive species are those considered sensitive by the California Department of Fish and Game. A list of Sensitive species that may occur in the pending lease area is provided below based on a search of the California Natural Diversity Database, correspondence with Modoc National Forest biologists, other documents as referenced, and understanding of the local habitat. Table 13.3-1 below lists species known to occur in the greater project area. There are no known Federally-listed special status species in the pending lease area.

Impacts

Potential impacts on threatened and endangered and special status species could occur if reasonably foreseeable future actions were to:

- Violate the Endangered Species Act, Migratory Bird Treaty Act, or applicable state laws; and/or
- Decrease a plant or wildlife species population to below self-sustaining levels.

Alternative A (No Action)

The No Action alternative would have no impact on special status species.

Table 13.3-1
Threatened and Endangered Species and Special Status Species Known to Occur in the Modoc National Forest

Scientific Name	Common Name	Status Federal[1]/State[2]/CNPPS[3]/ USFS
PLANTS		
Botrychium crenulatum	Scalloped moonwort	--/--/2.2
Botrychium lunaria	Common moonwort	--/--/2.3
Botrychium montanum	Western goblin	--/--/2.1
Botrychium pinnatum	Northwestern moonwort	--/--/2.3
Dimeresia howellii	Doublet	--/--/2.3
Lomatium grayi	Gray's lomatium	--/--/2.3
Mertensia oblongifolia var. amoena	Beautiful sagebrush bluebells	--/--/2.2
Mimulus evanescens	Ephemeral monkeyflower	--/--/1.B2
Orcuttia tenuis	Slender orcutt grass	
Silene oregano	Oregon campion	--/--/2.3
Synthyris missurica ssp. missurica	Kitten-tails	--/--/2.3
INVERTEBRATES		
Pseudocopaeodes eunus obscurus	Carson wandering skipper	E/--/--/
FISH		
Castostomus microps	Modoc sucker	E/E/--/
Catostomus warnerensis	Warner sucker	E/--/--/
BIRDS		
Accipiter gentilis	Northern goshawk	--/--/--/S
Aquila chrysaetos	Golden eagle	--/SC/--/S
Buteo regalis	Swainson's hawk	--/SC/--/S
Coccyzus americanus	Yellow billed cuckoo	C/E/--/--
Falco mexicanus	Prairie Falcon	--/--/--/S
Grus canadensis tabida	Greater sandhill crane	--/ST/--
Haliaeetus leucocephalus	Bald eagle	--/E/--/
MAMMALS		
Antrozous pallidus	Pallid Bat	--/SC/--/S
Corynorhinus townsendii	Townsend's big eared bat	--/SC/--/S
Martes Americana	American marten	--/--/--/S
Vulpes vulpes necator	Sierra Nevada red fox	--/ST/--

[1]Federal status:

FE = Endangered under the Endangered Species Act

FT = Threatened under the ESA

SOC = Species of concern

[2]California state status
SE =State Endangered; critically imperiled due to extreme rarity, imminent threats, and or biological factors
ST = State Threatened; Imperiled due to rarity and/or other demonstrable factors
SC = State species of concern; apparently secure, though frequently quite rare in parts of its range, especially at its periphery

[3]California Native Plant Society
1B.2 = Plants rare, threatened, or endangered in California and elsewhere: fairly threatened in California
2.1 = Plants rare, threatened, or endangered in California, but more common elsewhere: seriously threatened in California
2.2 = Plants rare, threatened, or endangered in California, but more common elsewhere: fairly threatened in California
2.3 = Plants rare, threatened, or endangered in California, but more common elsewhere: not very threatened in California
Source: California Natural Diversity Database 2008, Bureau of Land Management 2003

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on threatened and endangered and special status species; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Threatened and endangered species (including federal and state listed species and FS and BLM special status species) could be affected as a result of (1) habitat disturbance, (2) the introduction of invasive vegetation, (3) injury or mortality, (4) erosion and runoff, (5) fugitive dust, (6) noise, (7) exposure to contaminants, and (8) interference with behavioral activities.

Because of the regulatory requirements of the Endangered Species Act and various state regulations, the requirements specified in BLM Manual 6840 Special Status Species Management, and other resource-specific regulations and guidelines, any future geothermal activities would incorporate appropriate survey, avoidance, and mitigation measures. These measures would be identified and implemented prior to any geothermal activities in order to avoid adversely affecting any sensitive species or the habitats on which they rely.

13.3.11 Livestock Grazing

Setting

Three grazing allotments overlap the entire lease area. Table 13.3-2 shows the acreages of each grazing allotment within each pending lease site.

Table 13.3-2
Acreages of Grazing Allotments in the Proposed Lease Areas

	Grazing Allotment		
Lease	Bald Mountain	Davis Creek	Lassen Creek
CACA 042989	0	0	250
CACA 043744	1,200	160	1,100
CACA 043745	1,200	1,200	70

Impacts

Alternative A (No Action)

The No Action alternative would have no direct or indirect impact on livestock grazing.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on cultural resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Impacts would include loss of forage, reduced forage palatability because of dust on vegetation, and displacement of livestock from construction noise. Additional roads could also impact livestock by opening up areas that were not previously accessible, thereby increasing disturbance or harassment of livestock. However, creating new access roads to areas where livestock graze would help livestock operators manage their stock more efficiently.

Because of the large proportion of the lease sites being in Inventoried Roadless Areas, and the steep topography that is not suitable for grazing, impacts on livestock grazing are anticipated to be minimal.

13.3.12 CULTURAL RESOURCES

Setting

Cultural resources are past and present expressions of human culture and history in the physical environment and include prehistoric and historic archaeological sites, structures, natural features, and biota that are considered important to a culture, subculture, or community. Cultural resources also include aspects of the physical environment that are a part of traditional lifeways and practices and are associated with community values and institutions.

As in Volume I of the PEIS, discussions relevant to cultural resources in this document are found in three sections. Traditional cultural resources and traditional cultural properties are addressed in Section 13.3.13, *Tribal Interests and Traditional Cultural Resources*. Section 13.3.14 addresses *Historic and Scenic Trails*. Cultural resources in this section include the physical remains of prehistoric and historic cultures and activities.

The lease sites are within an archaeologically sensitive area of the western extreme of the Great Basin culture region as described in Appendix I of Volume III of the PEIS. The most prevalent cultural resource sites in the Surprise Valley area are associated with historic-era ranching and farming (Bureau of Land Management 2007). The peaks of the Warner Range, in which the leases sites are located, are the designated separation between the Great Basin and California culture regions. Cultural aspects of both regions likely existed within the lease areas. Within the Great Basin culture region, the Modoc NF/Surprise FO leases application sites are within the traditional territory of the Northern Paiute; however, the western boundary of this territory is at the peak ridgeline of the Warner Range. West of the range peaks is the traditional territory of the Achumawi of the California culture region. The area likely experienced influences from and occupations by both groups over time. Bengston (2003) provides a comprehensive ethnographic overview of the Northern Paiute. The following discussion is based primarily on that overview.

The earliest people to inhabit this area are referred to as Paleoindian and Archaic cultures (Gates 2008). Little is known about these groups. Bengston places the project area near the extreme western territorial boundary of the Northern Paiute. Comprised of individual bands, the majority of Northern Paiute territory is in Nevada (Bengston 2003). It is believed that the Northern Paiute entered the Great Basin approximately 1,000 – 5,000 years ago, most likely from the west. The Northern Paiute remained in the area and was one of the Native American groups encountered by historic European explorers. The prehistoric group is categorized as a fishing, hunting, and gathering group, subsisting on plant gathering, hunting of game, and fishing via traps, weirs, and nets in rivers and lakes. They were semi-nomadic moving across the landscape in seasonal rounds, utilizing temporary and easily-constructed structures. Winter camps were established typically near pinyon caches and temporary camps were established throughout territorial areas for the purposes of hunting and gathering (Bengston 2003). In the Surprise Valley area, winter camps were typically situated on the valley floor while base camps for resource exploitation activities during the summer were established in upland areas (Bureau of Land Management 2007). The Warner Mountain Range has been identified as an area of plant collection for local Northern Paiute and Pit River peoples (Bengston 2003; Gates 2008).

A variety of historic-era activities have been documented within the region of the proposed project. These included fur trapping during an initial period of Euro-American exploration, emigration and settlement by Euro-Americans, establishment of roads and trails, and mining. Fur-trapping potential was always marginal in the Great Basin, and expeditions ended in the early 1840s. As fur trapping declined, official government mapping and exploration expeditions were expanded into the Great Basin, partially to establish an American presence in what was, until 1848, Mexican territory. Later, several trails were established by emigrants, most passing through the region on their way to California during the Gold Rush (Bengston 2003). The most often used route to the California goldfields, the Applegate and Lassen Trail segments of the California National Historic Trail, entered California in Surprise Valley immediately east of the project area and continued on over Fandango Pass (Bureau of Land Management 2008). The first significant Euro-American incursions into the Surprise Valley area occurred in 1864 (Gates 2008) when drought in the Central Valley forced many cattle ranchers to relocate to northeast California where there was available grass and open range. Sheep and cattle ranching eventually became the dominate economy of the Surprise Valley area. Livestock would graze in the higher elevations and forested areas while hay was grown on the valley floor. Other historic economic activities of the area include logging, dairies, blacksmith shops, and other commercial interests, including a brief foray into mining (Bureau of Land Management 2007).

Data on cultural resources of the proposed lease areas were provided in April 2008 by Gerry Gates, Heritage Resource Program Manager for the Modoc National Forest and in May by the Northeast Information Center (NEIC) of the California Historic Resources Information System (NEIC File No. D08-29). The basic records search conducted by Mr. Gates revealed 25 previously recorded cultural resources within CACA 043745, two within CACA 043744, and none within CACA 042989. The NEIC records search covered non-FS lands within CACA 042989 and revealed one resource partially within the lease area and one additional site within one mile of the lease. Only the northern portion of CACA 043745 has had significant survey coverage for cultural resources. The rest of the Modoc lease areas have had limited to no survey coverage. Mr. Gates notes that level ground within the three lease areas, including ridge tops, benches, and terraces adjacent to drainages, is considered highly sensitive for previously undocumented cultural resources. Additionally, it is predicted that 30 to 50 more prehistoric archaeological sites are located within the unsurveyed portions of the lease areas (Gates 2008).

The majority of cultural resources within CACA 043745 are prehistoric. Nineteen lithic scatters have been identified, none of which have been previously evaluated for National Register of Historic Places (NRHP) eligibility and are therefore treated as eligible. Additionally, one quarry, one prayer seat, and one hunting blind all with associated lithic scatters have been identified within the lease area and are unevaluated. One other unevaluated hunting blind been identified as well. The large NRHP-eligible Buck Mountain ("Headwaters") Obsidian Source/Quarry Workshop is also within the northern portion of the lease area. The boundaries of this site have not yet been verified. There is one single unevaluated historic site within the CACA 043745 as well. Table 13.3-3 summarizes the cultural resources within Lease CACA043745. Only the northern portion of the lease has been extensively surveyed for cultural resources.

Table 13.3-3
Archaeological Sites within CACA 043745

FS Site No.	Trinomial	Description	FS Site No.	Trinomial	Description
FS-05-09-53-0133	CA-Mod-1099	Lithic Scatter	FS-05-09-53-0986	CA-Mod-3204	Lithic Scatter
FS-05-09-53-0413	CA-Mod-3189	Lithic Scatter/Quarry	FS-05-09-53-0987	CA-Mod-3205	Lithic Scatter
FS-05-09-53-0426	CA-Mod-2373	Buck Mtn. Obsidian Source	FS-05-09-53-0988	N/A	Lithic Scatter
FS-05-09-53-0602	CA-Mod-4444	Lithic Scatter	FS-05-09-53-0989	N/A	Lithic Scatter
FS-05-09-53-0668	CA-Mod-4445	Lithic Scatter	FS-05-09-53-0992	CA-Mod-3206	Hunting Blind
FS-05-09-53-0828	CA-Mod-3190	Lithic Scatter	FS-05-09-53-1017	CA-Mod-3207	Lithic Scatter
FS-05-09-53-0957	CA-Mod-3194	Lithic Scatter	FS-05-09-53-1110H	CA-Mod-4443H	Historic
FS-05-09-53-0974	CA-Mod-3198	Lithic Scatter	FS-05-09-53-1175	N/A	Lithic Scatter
FS-05-09-53-0975	CA-Mod-3199	Lithic Scatter	FS-05-09-53-1179	CA-Mod-4446	Lithic Scatter
FS-05-09-53-0982	CA-Mod-3200	Lithic Scatter	FS-05-09-53-1181	CA-Mod-4447	Lithic Scatter/Hunting Blind
FS-05-09-53-0983	CA-Mod-3201	Lithic Scatter	FS-05-09-53-1182	CA-Mod-4448	Lithic Scatter
FS-05-09-53-0984	CA-Mod-3202	Lithic Scatter/Prayer Seat	FS-05-09-53-1195	CA-Mod-4449	Lithic Scatter
FS-05-09-53-0985	CA-Mod-3203	Lithic Scatter			

Both cultural resources within CACA 043744 are prehistoric. One is a lithic scatter, FS Site No. FS-05-09-53-0133 (CA-Mod-1099), that has not been evaluated for NRHP eligibility. The second resource is the NRHP-eligible Buck Mountain ("Headwaters") Obsidian Source/Quarry Workshop, FS Site No. FS-05-09-53-0426 (CA-Mod-2373). This resource extends into CACA 043744 from CACA 043745 to the west, however its boundaries are not yet confirmed. Very little (less than 10%) of the lease application site has been previously surveyed for cultural resources.

No cultural resources were identified on FS lands within Lease CACA 04298 by Mr. Gates' records. The NEIC records search identified a portion of one prehistoric resource, CA-Mod-5891, on private lands within the lease and one additional site, CA-Mod-216, an obsidian source and possible quarry, as within one mile of the lease. The northwestern-most portion of CA-Mod-5891, a large lithic and groundstone scatter, extends into the CACA 04298 lease area. The site is considered an village site with loci of activity most often occurring on ridges and knolls and around hot springs. Furthermore, this site may correspond to an ethnographic Northern Paiute village (Northeast Information Center 2008). This site is considered eligible for the NRHP. None of the lease area, NFS lands or private lands, has been previously surveyed.

Consultation with federally recognized tribes that are affiliated with the lease area was initiated on September 12, 2007 to identify and assess historic properties that may be affected by the undertaking. No responses from local tribes have been received as of the date of publication, however consultation is considered on-going.

Until consultation with local Native Americans has been completed, it is unknown if there are Native American sites or sacred sites within or adjacent to the lease application sites. The presence of cultural resources within portions of the leases not previously surveyed is also possible. Table 13.3-4 summarizes available data on the cultural resources of the lease application sites.

Table 13.3-4
Cultural Resources in the Proposed Lease Areas

Lease CACA	Surveys (Percent)	NRHP-listed sites	NRHP-eligible sites	NRHP-ineligible sites	Unevaluated sites (Treated as NRHP-Eligible)
042989	0%	N/A	1	N/A	N/A
043744	<10%	N/A	1	N/A	1
043745	40-50%	N/A	1	N/A	24

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on cultural resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on cultural resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Completion of the Section 106 process of the National Historic Preservation Act requires the BLM and FS to consult with the State Historic Preservation Office, tribes and other parties to identify and assess historic properties affected by the undertaking and develop measures to avoid, minimize, or mitigate any adverse effects of the undertaking on historic properties.

Given the density of sites within the region, the presence of NRHP-listed and -eligible resources, and the general lack of survey coverage within the Modoc area leases, impacts on cultural resources could occur from subsequent permitted geothermal exploration, drilling operations and development, utilization, and reclamation and abandonment through ground-disturbing activities, unauthorized actions and alterations to setting and cultural landscapes. Mr. Gates surmises that geothermal development will likely result in adverse effects on archaeological resources within the lease areas. The nature of these impacts is described in Chapter 4 of Volume I of the PEIS. Additionally, as described in Chapter 2 of Volume I of the PEIS, various areas of cultural resources would have No Surface Occupancy stipulations: National Landmarks, National Register Districts, NRHP-listed and –eligible sites and their associated landscapes, traditional cultural properties, Native American sacred sites, and areas with important cultural and archaeological resources. Areas of potential effect would include access roads, well pads, power plant footprints, pipeline and transmission line routes, and construction staging areas as well as the boundaries of cultural resources those facilities cross and the aspects of setting that contribute to significance. These areas of potential effect would be developed at the project-specific level, and would require inventories, evaluations, and appropriate treatments as outlined in the best management practices of Appendix D in Volume III of the PEIS. Under these cultural resources best management practices, the BLM would also conduct Section 106 consultations with the State Historic Preservation Office, Native American tribes with ties to the project area, and local historic preservation groups to identify the presence and significance of cultural resources within or adjacent to the lease area and assess the level of impact of geothermal leasing and development on those resources. Project specific impacts after leasing would be reduced by implementing these best management practices.

13.3.13 Tribal Interests and Traditional Cultural Resources

Setting

Tribal interests include economic rights such as Indian trust assets, and resource uses and access guaranteed by treaty rights. Traditional cultural resources or properties include areas of cultural importance to contemporary communities, such as sacred sites or resource gathering areas. While most commonly considered in the context of Native Americans and Native Alaskans, there are traditional cultural resources associated with other ethnic or socially linked groups.

The lease application sites are within a culturally sensitive area of the western extreme of the Great Basin culture region as described in the Appendix I of the

PEIS. The peaks of the Warner Range, in which the leases sit, are the designated separation between the Great Basin and California culture regions. Cultural aspects of both regions likely existed within the lease areas. The lease application sites are within the traditional territory of the Northern Paiute. Bengston (2003) provides a comprehensive ethnographic overview of the Northern Paiute.

Bengston (2003) identifies several categories of Northern Paiute traditional property types including traditional origin and historic places, ceremonial locations, historical locations, ethnohistoric habitation sites, trails, burial sites, and resource collection areas. Locations of these kinds of areas are commonly kept confidential by tribes and are unknown to the general public and agencies. Additionally, several concerns and issues of the Northern Paiute bands are identified. These include concerns for culturally significant areas, the environment, land ownership, and the authenticity of ethnographic documentation of tribal information. The Walker Range has been identified as a traditional plant collection area.

The majority of Northern Paiute reservations were established in Nevada. However, five reservations and colonies were established in northeast California (Bengston 2003). The nearest reservations to the lease area are the Cedarville and Fort Bidwell Reservations to the south and northeast, respectively (Bengston 2003).

A records search conducted for NFS lands within the lease application sites identified two known traditional cultural properties are located on peaks adjacent to the lease areas (Gates 2008). An additional third traditional cultural property is within CACA 043745. These would be considered significant cultural resources to local Native Americans and tribes.

Consultation with federally recognized tribes that are affiliated with the lease area was initiated on September 12, 2007 to identify and assess additional tribal concerns and traditional resources that may be affected by the undertaking. No responses from the tribes have been received as of the date of publication; however, the consultation process is considered on-going. While many traditional cultural resources are well known, some locations or resources may be privileged information that is restricted to specific practitioners or clans. For tribes, maintaining confidentiality and customs regarding traditional knowledge may take precedence over identifying and evaluating these resources, unless they are in imminent danger of damage or destruction.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on tribal interests and traditional cultural resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on tribal interests and traditional cultural resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Impacts on Tribal Interests and Traditional Cultural Resources are assessed using the criteria found in Chapter 4 of Volume I the PEIS. Although no tribal interests or concerns have been identified by the consultation process, the consultation process is considered on-going. Additional resources or concerns may be identified in the future by tribes. Impacts on Tribal Interests would be minimized or avoided by implementing best management practices in Appendix D of Volume III of the PEIS for each of the phases of the Reasonably Foreseeable Development scenario as described in Chapter 2 of Volume I of the PEIS.

For traditional cultural resources, completion of the Section 106 process of the National Historic Preservation Act requires the BLM and FS to consult with the State Historic Preservation Office, tribes and other parties to identify and assess historic properties affected by the undertaking and develop measures to avoid, minimize, or mitigate any adverse effects of the undertaking on historic properties which includes traditional cultural properties. Three previously recorded traditional resources have been identified as within or adjacent to the lease areas, but no additional traditional resources have been identified by consulted tribes thus far. However consultation is considered on-going. Additionally, archaeological resources such as those discussed in Section 13.3.12, *Cultural Resources*, are often considered traditional resources by tribes.

Impacts on the known and potential traditional cultural resources could occur from geothermal exploration, drilling, utilization, and reclamation and abandonment through ground-disturbing activities, unauthorized actions and alterations to setting and cultural landscapes. The nature of these impacts and mitigations are described in Chapter 4 of Volume I of the PEIS. Areas of potential effect would include access roads, well pads, power plant footprints, pipeline and transmission line routes, and construction staging areas as well as the aspects of setting that contribute to significance. These areas of potential effect would be developed at the project-specific level, and would require inventories, evaluations, and appropriate treatments as outlined in the best management practices of Appendix D in Volume III of the PEIS. Under these cultural resources best management practices, the BLM would also conduct Section 106 consultations with the State Historic Preservation Office, Native American tribes with ties to the project area, and local historic preservation groups to identify the presence and significance of cultural resources within or adjacent to the lease area and assess the level of impact of geothermal leasing and development on those resources. Project specific impacts after leasing would be reduced by implementing these best management practices.

13.3.14 National Scenic and Historic Trails

Setting

The Lassen and Applegate trail segments of the California Historic Trail system traverse land approximately one mile from the NE corner of the NESE quarter section of township CA T44N R15E S14. Approximately 5,665 miles long, the trail was a major overland emigrant route across the Western US in the middle 19th century, used by over 200,000 farmers and gold-seekers to reach California (National Park Service 2008). The California National Historic Trail was the most often used route to the California goldfields, entering California in Surprise Valley immediately east of the lease area and continuing on over Fandango Pass (Bureau of Land Management 2008).

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on national scenic or historic trails.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impacts on national scenic or historic trails; however, anticipated future actions associated with development of geothermal resources could cause such impacts. As stated in Section 4.16 of the PEIS, no geothermal leasing is allowed within one mile of a National Scenic or Historic Trail. Because the distance from the trail to the northeastern corner of the SE quarter section of Section 14, impacts could occur should development at CACA 042989 occur. Depending on the type of structural development and roads needed, the proposed development could be visible from the trail and directly impact the visual character of the trail. The BLM would need to conduct an on-the-ground study determine the effects that development on CACA 042989 lease site would have on the trail. If necessary, the BLM may need to revise the lease boundaries to remove the 1-mile buffer from CACA 042989 prior to issuing the lease.

13.3.15 Visual Resources

Setting

This section describes the visual resources in the region of influence, which is defined as the areas within and immediately surrounding the pending lease areas. Described below is the method for managing scenic resources and the visual landscape of the pending lease areas.

The scenery of the Forest is managed through the application of the Visual Management System (Agricultural Handbook- 462, National Forest Landscape Management, Volume 2, Chapter 1, The Visual Management System). The Visual Management System was adopted by the Forest Service in 1974. The key component of the Visual Management System is the establishment of Visual Quality Objectives within the Land and Resource Management Plan.

There are five differing levels of Visual Quality Objectives (Visual Quality Objectives): Preservation, Retention, Partial Retention, Modification, and Maximum Modification. The following is a brief description of the five Visual Quality Objectives:

- Preservation – Allows ecological change only. Management activities are prohibited except for very low visually impacting recreation facilities.
- Retention – Management activities may not be visually evident. Contrasts in form, line, color and texture must be reduced during or immediately after the management activity.
- Partial Retention – Management activities must remain visually subordinate to the characteristic landscape. Associated visual impacts in form, line, color and texture must be reduced as soon after project completion as possible but within the first year.
- Modification – Management activities may visually dominate the characteristic landscape. However, landform and vegetative alterations must borrow from naturally established form, line, color or texture so as to blend in with the surrounding landscape character. The objective should be met within one year of project completion.
- Maximum Modification – Management activities including vegetative and landform alterations may dominate the characteristic landscape. However, when viewed as background they must visually appear as natural occurrences within the surrounding landscapes or character type. When viewed as foreground or middle ground, they may not appear to completely borrow from naturally established form, line, color, or texture. Alterations may also be out of scale or contain detail which is incongruent with natural occurrences as seen in foreground or middle ground. Reduction of contrast should be accomplished within five years.

The pending lease sites are almost entirely within an Inventoried Roadless Area and visual retention zone. Appendix I of the Modoc National Forest Land and Resource Management Plan contains special stipulations for geothermal, oil, and gas leasing (US Forest Service 1991). A stipulation pertaining to visual resources protects highly scenic and sensitive visual areas as identified in Visual Quality Objectives as Retention and those areas identified in the Recreation Opportunity Spectrum as Semi-Primitive Non-Motorized. The Forest Service will require that the lessee's or operator’s plan of operation is consistent with this stipulation, and may require restrictions or modifications to the operating plan. To protect areas, the lessee shall not conduct surface disturbing activities.

According to the Modoc National Forest Land and Resource Management Plan, the Forest offers a wide range of scenic landscapes (US Forest Service 1991). The Medicine Lake Highlands in the northwest portion of the Forest provides the beauty of mixed conifer stands intermixed with geologic evidence of past volcanic action (US Forest Service 1991). The Modoc Plateau, covering most of the Forest, is a combination of lava outcroppings with a diverse mixture of ponderosa pine stands, juniper, bitterbrush, sagebrush and mountain mahogany. The variety of vegetative color and texture and the distant views to mountain backdrops provide a unique scenic experience.

The Warner Mountains rise above the surrounding plateau on the east side of the Forest with peaks up to 9,800 feet (US Forest Service 1991). The Warner Mountains offer all the scenic amenities of the Sierra Nevada mountain range, and are covered by broken and diverse patterns of coniferous forests, aspen stands, open shrub-covered patches, rock outcrops and numerous streams.

The pending lease areas are in the foothills east of the Warner Mountains and west of both Upper Lake and California State Route 1. Prominent peaks in the area include Little Baldy (approximately 2,200 feet) and Buck Mountain (approximately feet). Rough roads, Lake City Canyon, Boyd Creek, Powley Creek, Wilkinson Creek, Mill Creek, and Davis Creek South Fork cross the pending lease areas. The rolling hills are tan and dotted with sparse vegetation. The valleys and canyons with denser refuges of green vegetation visually contrast with the higher hilltops and ridges. Human-made modifications to the visual landscape are limited to roads of various conditions.

The Surprise Valley/Barrel Springs Back Country Byway is a route through Surprise Valley along a paved country road through quiet, small communities of white-framed houses, tall trees and gardens (Bureau of Land Management 2008). It follows State Route 1 past the pending lease areas. The Barrel Springs backcountry byway relies on the visual setting as a key component of the recreation opportunity experience (Bureau of Land Management 2007). With the exception of State Route 1, there are no sources of light in the pending lease areas.

Although some of the activities briefly described in CACA 043745 occur within CACA 043744 as well, there are far fewer activities due to the lack of road access and topography. The CACA 042989 area under Forest Service management is accessible by foot only.

Impacts

The pending lease sites on NFS land are designated with a Retention Visual Quality Objective.

Alternative A (No Action)
The No Action alternative would have no impact on visual resources.

Alternative B (Proposed Action)
The Proposed Action would not have any direct impact on visual resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. The potential risk of changes affecting visual resources is assessed for five significance criteria, which are described in Chapter 4 of the PEIS. Future actions based on the RFD scenario could result in changes that impact visual resources.

Future geothermal development activities could involve new structures, roads, and operations that are described in the RFD scenario. The new structures, roads, and operations would alter the characteristic landscape and be sources of light and glare. Because the pending lease areas are relatively undeveloped and readily visible due to topography and lack of obstructions, the impacts on visual resources would be noticeable. These impacts would be near areas where recreation (hunting, hiking, fishing) takes place or near areas where minimal nearby development exists. It would also be near a backcountry byway. Although stipulations outlined in Appendix B of the PEIS would minimize these impacts, geothermal resource development activities would be visually evident. Changes to visual resources based on the RFD scenario would result in impacts on visual resources that would not be consistent with a Retention Visual Quality Objective.

13.3.16 Socioeconomics and Environmental Justice

Setting

The leasing sites cover approximately 5,200 areas within Modoc County. The County was selected as the region of influence for socioeconomic analysis as the impacts of leasing are likely to occur within this region. A summary of the population, housing, employment, local school data and low-income and minority populations for the County is provided based primarily on data from Census 1990 and 2000 population, demographic and housing information (US Census Bureau 1990. 2000).

Population
In 2006, population in Modoc County was estimated at 9,587. This is a 1.6 percent population change from 2000, when the total population within the county was 9,449. Between 1990 and 2000 population decreased by approximately 2.3 percent. Projections for 2020, place Modoc county at a population of 11,500 (California Department of Finance 2001).

Housing

In 2000, there were 4,807 total housing units, 3,784 of these were occupied and 2,675 owner occupied, for an owner vacancy rate of 5.1 percent and a rental vacancy rate of 9.3 percent. In 1990, there were 4,672 total housing units, of which 3,711 units were occupied and 2,583 were owners occupied, with an owner vacancy rate of 3.6 and a rental property vacancy rate of 7.8 percent (US Census Bureau 1990. 2000).

Employment

In 2000 the workforce consisted of 4,128 people of which 493 people or 10.2 percent were unemployed. This is a slight decrease in unemployment from previous census data in 1990, when the labor force consisted of 3,982 people of which 418 people, 10.5 percent were unemployed. Median household income was $27,522 in 2000 and in 1990 median income was $22,029. Median income is lower than the state average, which was $47,493 in 2000 (US Census Bureau 1990, 2000). Some of this difference may be due to unreported income from activities such as fuel wood gathering and family farm labor as well as seasonal employment fluctuations.

Based on 2000 data, the industries employing the greatest percent of the population in Modoc County include educational, health and social services (25.4 percent); agriculture, forestry, fishing and hunting and mining (18.2 percent); public administration (10.1 percent) and retail trade (12.3 percent) (US Census Bureau 2000).

Schools and Public Infrastructure

In 1990, 1843 students were enrolled in K-12 education in Imperial County. In 2000 this number increased to 2,005 students. Modoc County includes Modoc Joint Unified School District, Surprise Valley Joint Unified School District and Tulelake Basin Joint Unified School District (Modoc County Office of Education 2007).

Environmental Justice

The Caucasian/Non-Hispanic population is the dominant ethnicity in Modoc County, at approximately 85.9 percent of the population in 2000. The Hispanic/Latino population increased 37 percent from 1990 to 2000. In 2000, Hispanic/Latinos comprised approximately 11.5 percent of the population. 2006 estimates indicate that this minority comprised 11.8 percent of the population in 2006, indicating that Hispanic/Latino population is continuing to increase in the county (US Census Bureau 2008). See Table 13.3-5 for a summary of population in Modoc County by ethnicity.

Table 13.3-5
Race/Ethnicity in the Modoc County

	1990	2000	Percent Change
Total Population	9678	9449	-2.3
White/Non-hispanic	8803	8120	-7.8
Black/African American	78	65	-16
American Indian/Alaskan Native	406	398	-2.0
Asian	40	58	+31
Pacific Islander*	N/A	7	N/A
Other	351	538	+35
Two or more*	N/A	263	N/A
Hispanic or Latino**	701	1088	+36

Source: US Census Bureau 1990. 2000.
* Not reported on1990 census: Asian and Pacific Islanders were one group and more than one race was not an option.
** In combination with other race. Totals may add to more than 100 percent as individuals can report more than one race.

In 1999 census information, people, or 21.5 percent of individuals for whom poverty status was determined were living below the poverty level. This is an increase over 1989 data, which indicated that approximately 1,396 individuals or 15 percent of the population were living below poverty level (US Census Bureau 2000).

Impacts

Alternative A (No Action)
The No Action alternative would have no impact on existing socioeconomics in Modoc County. No impacts would occur to minority or low income populations.

Alternative B (Proposed Action)
The Proposed Action would not have any direct impact on socioeconomics or environmental justice; however, geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Potential impacts include a potential increase in jobs and decrease in unemployment in Modoc County due to construction and operations and maintenance jobs at a newly developed geothermal plant. Given the reported unemployment rate of over 21 percent in 2000, it is likely that many of the jobs created by a power plant would be filled by county residents and should not result in a large population influx. As a result, impacts on local schools or other public infrastructure would be minimal. Geothermal development would also be a positive stimulus to the local economy through increased tax revenues at the county and state levels.

The RFD scenario predicts two 20 MW plants will be developed in the pending lease area. Impacts of a standard 50 MW plant are discussed in Section 4.18.3 *Socioeconomics and Environmental Justice* in Volume I of the PEIS. Similar impacts to those discussed in the PEIS are likely for this pending lease area; however, impacts would be reduced according to the smaller capacity of the plants in the pending lease area. Impacts on Hispanic/Latino individuals or individuals of low income populations are possible as these groups have a significant presence in the County. Due to the absence of residences in and around the pending lease sites impacts would be minimal.

13.3.17 Noise

Setting

Current sources of noise in the pending lease areas are limited to wind, dispersed recreational use, occasional traffic on roads within the leasing site boundaries, and wildlife. Sources of noise originating outside of the pending lease areas but affecting the pending lease areas include traffic from adjacent roads, air traffic, and activity from a nearby residence.

Sensitive noise receptors are generally considered to be homes, hospitals, schools, and libraries. Sensitive receptors within the pending lease area are limited to one residence located along Surprise Valley Road, approximately between 180 and 230 yards to the east and southeast of proposed lease site CACA 042989. No other residences or developments lie within half a mile of the site. Wildlife is also considered to be a sensitive noise receptor, depending on the species present in the project area. Wildlife in the project area is discussed in sections 13.3.9, *Fish and Wildlife*, and 13.3.10 *Threatened and Endangered Species and Special Status Species*.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on noise.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on noise; however, geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. No sensitive receptors have been identified within the pending lease areas. Adjacent and nearby sensitive receptors would be protected from noise impacts since any projects approved by the BLM would be required to adhere to the BLM regulations, requiring that noise from a major geothermal operation shall not exceed 65 A-weighted decibels at the lease boundary. Impacts on wildlife from noise sources are discussed in Sections 13.3.9, *Fish and Wildlife*, and 13.3.10 *Threatened and Endangered Species and Special Status Species*.

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CHAPTER 14

HUMBOLDT-TOIYABE NATIONAL FOREST

BATTLE MOUNTAIN DISTRICT

ANALYSIS FOR PENDING LEASE APPLICATION:

NVN 074289

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SECTION 14.1 INTRODUCTION

14.1.1 INTRODUCTION

This environmental analysis describes the environmental effects of leasing approximately 440 acres of NFS (160 acres), public (160 acres) and private (120 acres) land within the Austin-Austin and Tonopah Ranger Districts of the Humboldt-Toiyabe National Forest and within BLM Battle Mountain Field Office to private industry for the development of geothermal resources.

The pending lease site is partially within NFS lands (the Austin-Austin and Tonopah Ranger Districts of the Humboldt-Toiyabe NF), public lands (within the BLM Tonopah Field Office of the Battle Mountain District), and private lands. The FS is the surface management agency for the NFS lands portion of the site, and the BLM Battle Mountain District is the surface management agency for the public land portion of the site. For the NFS lands portion of the lease site, the Battle Mountain District issues leases with the consent of the FS (here, the Austin and Tonopah Ranger Districts of the Humboldt-Toiyabe NF) for the lands under application in the Humboldt-Toiyabe NF. Subsurface mineral rights are managed by the Battle Mountain District for all NFS, public, and private lands within the lease site.

This lease-specific analysis serves as an information resource to aid decision-makers in determining whether these lands are appropriate for leasing under FS and BLM management policies and existing environmental regulations.

14.1.2 LOCAL REGULATORY CONSIDERATIONS

The pending lease application site is located within Nye County, Nevada and is subject to state and local regulations, as described below.

State of Nevada Renewable Portfolio Standard Program

The Nevada Renewable Portfolio Standard Program is a Nevada law that requires investor-owned utilities in Nevada to provide 20 percent of their retail sales of electricity from clean, renewable sources of energy in 2015. Geothermal energy is included in the definition of renewable resources under the program.

Toiyabe National Forest Land and Resource Management Plan (1986), as amended

The Humboldt-Toiyabe NF operates under the direction of the Record of Decision (ROD) for the Toiyabe National Forest Land and Resources Management Plan (Forest Plan), as amended. The Forest Plan provides the following forest management direction in relation to minerals, including geothermal:

1. Encourage exploration and development of mineral resources and minimizing possible adverse impacts on surface resources.
2. Require an operating plan on all mineral operations that will cause surface resource disturbance.
3. Process notices of intent (NO1) and operating plans (OP) in accordance
4. Require operating plans which minimize impacts on surface and cultural resources and provide for reclamation of disturbed areas.
5. Insure conformity with operating plans through regular compliance inspections.
6. Require reclamation bonds commensurate with the requirements of reclamation plans.
7. Require reclamation plans to achieve the repair of surface disturbances and to return the area and natural resource values to as near pre-existing conditions as possible.
8. The following "Access and Reclamation Measures" will be encouraged for mineral exploration Forest-wide and will be emphasized in areas where surface resource values are considered highly sensitive and where the physical character of the land, such as terrain and soil type, permit their use:
    a. Close or obliterate access unless identified to become part of the transportation system after mineral activity is complete.
    b. Minimize need for road construction through the use of specialized exploration equipment.
    c. Develop access to a standard necessary to minimize resource impacts and to facilitate reclamation. Development standards and reclamation criteria will be subject to Forest engineering review when land disturbing activities are proposed in areas identified as having highly sensitive resource values.

d. Where new road and drill pad construction is essential for exploration access, such roads and other disturbed areas will generally be closed and stabilized by revegetation and recontouring where necessary to restore site productivity, to protect or restore visual quality, and to minimize resource conflicts.

e. Identify and save topsoil needed for reclamation prior to disturbance.

9. Input from county officials and others, as appropriate, will be considered before existing or proposed primary access roads are closed.

10. Validity examinations by qualified geologists will be conducted on a case-by-case basis to substantiate mineral patent applications and proper use of mining claims on the Forest.

11. Action will be taken on cases of abuse of mining laws, such as occupancy for purposes other than mining and mining related activities.

12. Informal mineral evaluations may be conducted by qualified geologists, mining engineers, or mineral specialists before operating plans are approved in primitive, semi-primitive nonmotorized, and environmentally evaluation results in disagreement between the mineral operator and the Forest Service, the operator will have an opportunity to request the opinion of a consulting geologist.

13. Conduct validity exams on all operations proposed in wilderness. Validity exams may be conducted for development proposals in RNA's and proposed wildernesses.

14. Recommendations will be made to the Secretary of Interior concerning extension, removal, or modification of existing withdrawals.

15. Prepare mineral evaluations for proposed withdrawals and land exchanges.

16. Review and process all lease applications submitted by the BLM in a timely fashion. Specific stipulations are described in Table IV-7 and Appendix B of the Plan.

17. Provide counties with an opportunity to review geothermal lease applications to ensure that proper stipulations are included.

18. Except for mine sites where applicable, utilize existing borrow sites for common variety materials before new sites are developed.

19. Process requests for new common variety material sites through the NEPA process. Except for mine development where applicable,

new sites will be developed on the Forest only when alternative sites off the Forest are not reasonably available.

20. Utilize the state permitting process for handling mineral dredging operations when applicable.
21. The Forest will work with industry to continue development of cost effective and environmentally sound reclamation procedures through research and experimentation.
22. The Forest will work with industry to further the development and use of drilling equipment, such as track-mounted drill rigs, that will result in effective exploration methods with the least impact on surface resources.
23. Reasonable access for mineral exploration, development, and production is guaranteed under the mining laws. The type of access approved will be consistent with the logical development of mineral properties.
24. The claimant/operator may be required to submit assay or other data, or identify mineral showings so that Forest Service mineral specialists can verify that the access proposed would be the next logical step in development.

Tonopah Resource Management Plan and Record of Decision (1997)

The pending lease area is managed under the Tonopah Resource Management Plan and Record of Decision (Tonopah RMP). The Tonopah RMP identifies 5,360,477 acres (88% of the Tonopah Planning Area) as open to fluid mineral leasing subject to standard lease terms and conditions, and 607,799 acres as closed. A further 72,400 acres are identified as open to leasing with seasonal restrictions due to crucial wildlife habitat, and 50,425 acres are identified as open subject to no-surface-occupancy. The RMP notes that the determinations apply to geophysical exploration, and that waivers to the determinations will be considered if the identified resource values can be protected.

14.1.3 Scope of Analysis and Approach

This lease-specific analysis incorporates by reference the programmatic analysis presented in Volume I to which this lease-specific analysis is included. This analysis examines the pending noncompetitive lease application site NVN 074289, describes the Reasonably Foreseeable Development scenario for this site, examines the existing environmental setting, and describes the potential direct, indirect and cumulative impacts that issuing the lease, and the anticipated future actions following leasing, would have on the human and natural environment.

This report focuses on specific key resource concerns in the pending lease area, and incorporates by reference the impacts described in the PEIS. Decision-makers should consider both the impacts described in this lease-specific analysis, in addition to those described in the main body of the PEIS. The analysis presented here does not reiterate the details of impacts identified in the PEIS, but rather refers to them as they arise in the impact analysis for proposed lease application sites addressed here. Humboldt-Toiyabe NF and Battle Mountain District staff members were contacted during the preparation of this lease-specific analysis to help identify local resource concerns.

14.1.4 CUMULATIVE ACTIONS

Consultation with the Humboldt-Toiyabe NF and Battle Mountain District revealed that other geothermal leasing and exploration activities are occurring to the northeast of the lease site on private lands. Continued geothermal well-drilling, and possibly a power plant, is expected in this area.

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SECTION 14.2
PROPOSED ACTION AND ALTERNATIVES

14.2.1 INTRODUCTION

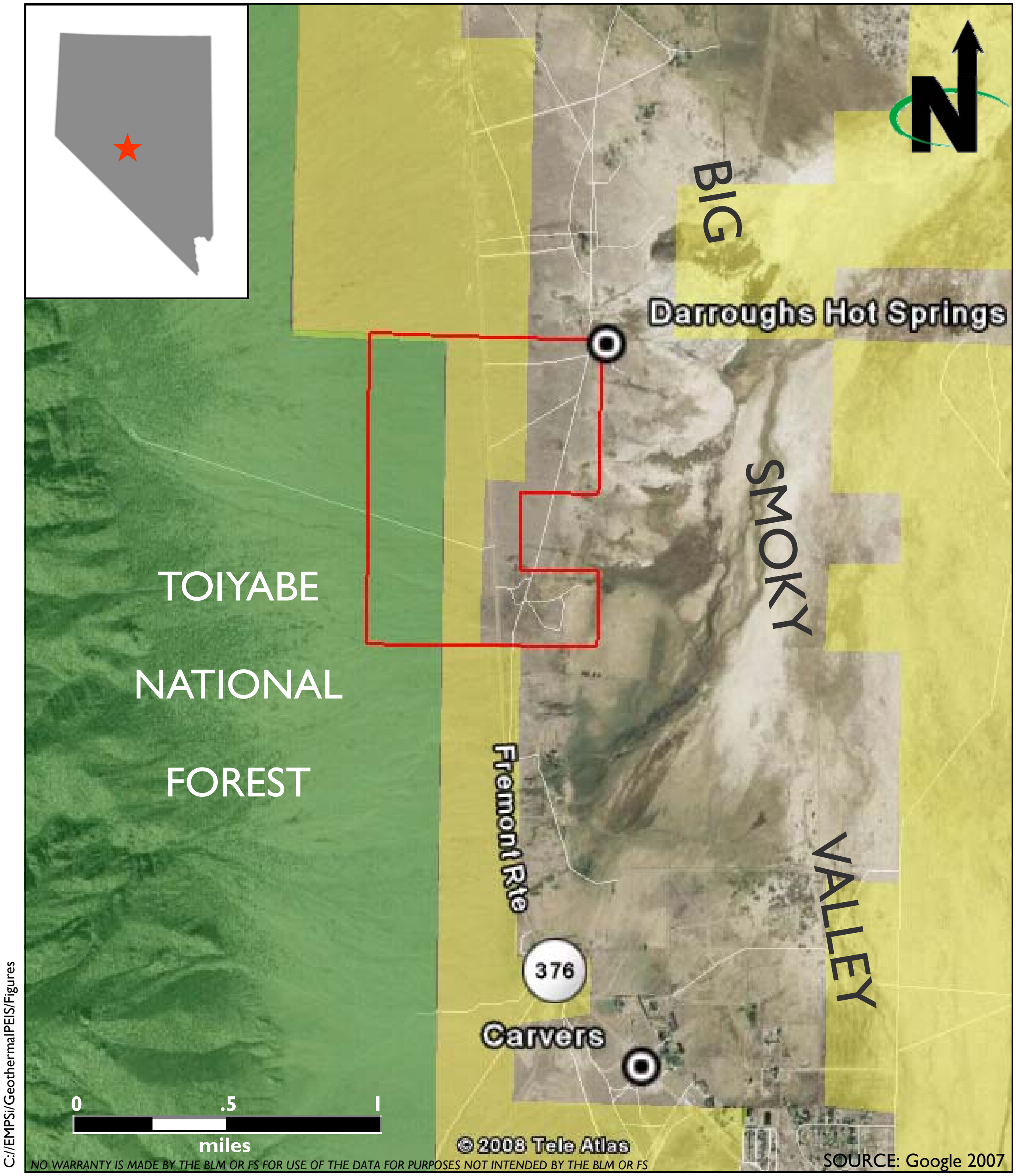
This chapter provides the details of the proposed action, alternatives to the proposed action, and an overview of the Reasonably Foreseeable Development scenario for pending noncompetitive lease application site NVN 074289.

14.2.2 PROPOSED ACTION

The proposed action is for the FS to provide a consent determination to the BLM to issue the lease to the lease applicant for one area within the Humboldt-Toiyabe National Forest and for the BLM to issue the lease, which encompasses the aforementioned NFS land in addition to BLM and private land. The 440 acres of land lie along the western edge of the Big Smoky Valley, just below the lower slopes of the eastern side of the Toiyabe Range, in Nye County, Nevada (see Figure 14-1). Lease boundaries could be adjusted in the decision to avoid unacceptable impacts on sensitive resources.

There is one pending lease application included within this area. NVN 074289 includes 440 contiguous acres of land. The legal description for this land is T11N R43E S18, parts E2W2, NE, W2SE, SESE, Lots 1-4. The site ranges in elevation from 5,600 feet to 5,900 feet above mean sea level. The western portion of the land (E2W2; 160 acres) lies within the Humboldt-Toiyabe NF, while the eastern portion of the site is on public (W2E2; 160 acres) and private (SESE, E2NE; 120 acres) lands.

Two roads traverse the site: Cove Canyon Road and State Route 376 (Fremont Route). Several additional unmarked roads crisscross the southeastern portion of the site. The nearest airport is the Wine Glass Ranch airport, approximately 0.6 mile to the southeast of the site.



Lease site NVN 074289 is located on NFS land, BLM land, and private land.

LEGEND:
- Lease site boundary
- NFS land
- BLM land

Lease Location
NVN 074289
Toiyabe NF / Battle Mountain FO

Figure 14-1

There are no buildings within the proposed lease sites. The closest known buildings are 0.4 mile to the south of the proposed lease site at Wineglass Ranch, and 0.5 miles to the east at Darroughs Hot Springs.

14.2.3 ALTERNATIVES

Two alternatives are considered in this lease-specific analysis: Alternative A, the No Action alternative, and Alternative B, the Proposed Action.

Alternative A: No Action

Under Alternative A, the FS would not issue a consent determination for the lease, and the BLM would not issue the lease.

Alternative B: Proposed Action

Under Alternative B, the FS would provide a consent determination for the lease application and the BLM would issue the lease with the stipulations identified in Chapter 2 of the PEIS.

14.2.4 REASONABLY FORESEEABLE DEVELOPMENT SCENARIO

The proposed lease site is likely to be developed for electricity generation. The pending noncompetitive lease application was filed by Lillian Darrough (owner of the nearby Darroughs Hot Springs) in 2001, but represents a partnership with Great American Energy. Communication from Great American Energy defines the likely development of the site as being a single, 12 megawatt binary power plant (Great American Energy 2008a). The development of this plant would be expected to result in approximately 10 acres of disturbance. The NFS lands portion of the lease site (western portion) are within an Inventoried Roadless Area, making it unlikely that any development would occur in that area; therefore, it is expected that development would take place in the eastern part of the lease site, which is comprised of public and privately owned lands.

Exploration activities for a 12-megawatt plant is expected to involve approximately 6 temperature gradient holes, disturbing approximately 0.15 acre each, for a total disturbance of approximately 1 acre. Disturbance would result from the types of activities described under Chapter 2 of the PEIS under *Phase One: Geothermal Resource Exploration*.

Assuming that a commercially viable resource is found within the lease area, drilling operations and development of the site would be expected to result in a further approximately three acres of land disturbance from the types of activities described in the Reasonably Foreseeable Development scenario of Chapter 2 of the PEIS under *Phase Two: Drilling Operations*.

Utilization, the third phase of a geothermal project, is expected to result in a further approximately six acres of land disturbance from the types of activities described in the Reasonably Foreseeable Development scenario of Chapter 2 of the PEIS under *Phase Three: Utilization*. Great American Energy plans to connect to the existing 29-kV line that parallels the highway and runs through the Darrough's fee lands. The 29-kV line connects to the Round Mountain substation on the 230-kV line. No additional transmission lines or routes are contemplated (Great American Energy 2008b).

Reclamation and abandonment, the fourth phase of a geothermal project, is expected to result in temporary disturbance of all originally disturbed acres, after which, the site would graded and vegetated to pre-disturbance conditions, as described in the Reasonably Foreseeable Development scenario of Chapter 2 of the PEIS under *Phase Four: Reclamation and Abandonment*.

SECTION 14.3
AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

14.3.1 INTRODUCTION

The following resource disciplines are not addressed in this section because they are not found in the leasing areas and are not relevant to the discussion: livestock grazing, national scenic and historic trails and special designations.

No wild horse and burro herd territories or herd management areas exist within 10 miles of the pending lease area, therefore wild horses and burros will not be brought forward for analysis.

All the pending lease applications are in geologic units that would be expected to have a relatively low potential for containing vertebrate fossils or scientifically significant invertebrate or plant fossils; therefore, paleontological resources are not analyzed in detail. Paleontological mitigative procedures outline in the PEIS would be followed for all ground distributing activities. Protective measures outlined in the PEIS would be applied.

Future development of the proposed lease sites would also yield the same health and safety impacts as identified in Chapter 4 of Volume I of the PEIS and therefore is not repeated in this lease-specific analysis.

Cumulative impacts are only discussed for those resources that are likely to experience cumulative impacts from the proposed action, and from the cumulative actions identified in Section 14.1.4.

14.3.2 LAND USE, RECREATION

Setting

This section is a discussion of the current land ownership and use within the Region of Influence (Region of Influence) for the proposed lease site.

The Region of Influence is the land area within and adjacent to the proposed lease site.

Policies and Plans
It is the policy of the Department of the Interior, consistent with Section 2 of the MMPA and Sections 102(a) (7), (8) and (12) of FLPMA, to encourage the development of mineral resources, including geothermal resources, on federal lands. The Geothermal Steam Act of 1970 provides regulatory guidance for geothermal leasing by the BLM.

The Humboldt-Toiyabe Forest Land Management Plan (Forest Plan) and the BLM Tonopah Resource Management Plan (Tonopah RMP) provide direction for the leasing of geothermal resources. Additional detail of these plans is provided in Chapter 1 of this lease-specific analysis, under *Local Regulatory Considerations***.** The Tonopah RMP identifies the pending lease area as open to fluid mineral leasing subject to standard lease terms and conditions.

Regional Setting
The pending lease area consists of approximately 606 acres of land along the western edge of the Big Smoky Valley, below the eastern slope of the lower Toiyabe Range. The western portion of the proposed lease site lies within the Humboldt-Toiyabe NF, the center portion of the site is on public land and the far eastern portion is privately owned (see Figure 1). As shown in Figure 1, adjacent land ownership includes NFS, public and private.

Lands immediately adjacent to the proposed lease site are primarily non-developed. The closest development is at Wineglass Ranch, approximately 0.4 miles to the south of the proposed lease site and at Darroughs Hot Springs, 0.5 miles to the east.

There are no designated recreation areas within or adjacent to the proposed lease site. In the Humboldt-Toiyabe NF, common dispersed recreational activities include hiking, camping, fishing, hunting, OHV recreation, horseback riding, bird and wildlife viewing, photography and pine nut collecting (US Forest Service 1986).

The nearest population center is Tonopah, which is approximately 50 miles south of the proposed lease site and has a population of approximately 2,800.

Pending Lease Areas
The Western portion of the pending lease area lies within Management Area 8 in the Humboldt-Toiyabe NF. Management direction for this area dictates that development of minerals be "*done in a manner that protects key dispersed recreation, wildlife, and fisheries resources.*" Prescriptions for the management area include areas for wilderness preservation; Intensive wildlife and dispersed recreation; and market opportunities (US Forest Service 1986). The NFS lands

within the lease site are all within an Inventoried Roadless Area. Cove Canyon Road passes through this portion of the site in an east-west alignment.

Cove Canyon Road and the Fremont Route as well as additional unnamed roads provide access to portions of the pending lease area. Darroughs Hot Springs is located in the In the NENE of section 18 and additional hot springs are found within 0.5 mile of the pending lease area to the north.

No special land use areas are contained with or adjacent to the leasing area. There are no known trails or official recreation uses on the proposed lease site.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on existing land uses, including existing recreational uses.

Alternative B (Proposed Action)

The Proposed Action would not cause any direct impacts on land use or recreation; however, the anticipated future actions likely to follow leasing would potentially result in such impacts. The Proposed Action would be consistent with Forest Plan the Tonopah RMP and applicable land classifications within these plans, provided that specific management guidelines are followed. The Reasonably Foreseeable Development scenario predicts that one 12 megawatt plant will be developed at eastern portion of the proposed lease site. Approximately 10 acres of disturbance is expected as a result of plant development. Typical impacts for a 50 megawatt plant on land use, recreation and special designations are discussed in detail in Section 4.2.3 of the PEIS. Plant construction and utilization may impact certain dispersed recreational uses in the pending lease area, specifically hunting, bird and wildlife viewing, and horseback riding.

Impacts on Inventoried Roadless Areas

The NFS portion of the lease sites is within an Inventoried Roadless Area. As such, no new road construction would be permitted on the NFS lands within the project site. Since roads are critical to powerplant and wellfield development, only minimal development along the edge of the Inventoried Roadless Area would be possible. It is expected that no development would occur in the Inventoried Roadless Area and that the area would not be affected by the proposed project.

Cumulative Impacts

The Proposed Action could indirectly cumulatively contribute to an overall trend in land use changes in the Smoky Valley from undisturbed landscape, to developed uses.

Neither the anticipated future actions following leasing under the Proposed Action, nor the nearby geothermal activities occurring on private land would conflict with any land use designations under the Nye County General Plan, or local BLM or FS land use regulations.

Cumulative impacts on dispersed recreational uses would be minimal due to the minimally developed local environment and the large expanses of land available for recreation in the region.

14.3.3 Geologic Resources and Seismicity

Setting

The proposed lease site lies within the Great Basin area of the Basin and Range geological province. This province, characterized by steep, elongate mountain ranges alternated with long expanses of flat, dry desert, extends from eastern California to central Utah, and from southern Idaho into the state of Sonora in Mexico. Within the Basin and Range province the earth's crust and upper mantle have been stretched up to 100 percent of its original width. The entire region has been, and continues to be, subjected to extension that thinned and cracked the crust as it pulled apart, creating large, north-south trending faults (US Geological Survey 2004).

Expansion occurs in a roughly east-southeast to west-northwesterly direction at the rate of 13 mm/yr (US Geological Survey 2008a). Beginning approximately 20 million years ago, the upthrown side of these faults began to form mountains that rise abruptly and steeply, and the down-dropped side created broad, low valleys, resulting in the provinces' distinctive alternating pattern of linear mountain ranges and valleys. The fault plane extends deep into the crust, usually at a 60 degree angle. In places, the relief or vertical difference between the two sides is as much as 10,000 feet. As the ranges rise, they are immediately subject to weathering and erosion from water, ice, wind, and other agents (US Geological Survey 2004).

The mountain ranges consist of complexly deformed late Precambrian and Paleozoic rocks and some Mesozoic granitic rocks in the western part of the province. Cenozoic volcanic rocks are widespread throughout the province. Eroded material washes down mountain side, often covering young faults until they rupture again. Sediment collects in adjacent valleys, in some places covering bedrock under thousands of feet of rock debris (US Geological Survey 2004).

In the past 150 years, there have been 14 earthquakes in the Great Basin large enough to rupture the earth's surface. Roughly 20 percent of the faults in this area have evidence of surface rupture in the past 15,000 years. Except for aftershock activity associated with some historical ruptures in the province, it is difficult to associate recorded seismicity with specific faults. There are virtually no examples of foreshock activity preceding large earthquakes. For the most part, normal faults within the Great Basin seem to be a seismic and locked, but some may be closed to the point of failure (US Geological Survey 2008a).

The lease site lies in one of the province's broad valleys. The Toiyabe Range fault zone, a late-quaternary fault zone, passes into the lease site. Fault lines are concentrated in the NENE, NWNE, NESE and SESE portions of the lease site.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on geological resources, and would not put any people or structures at risk from seismic-related events because no ground-disturbing activities would be approved.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impacts on geological resources or put people or structures at risk from seismic events; however, anticipated future actions following leasing could have impacts on these resources and result in risks related to seismicity. Issuing leases for the proposed lease sites would likely be followed by the development of geothermal resources at the sites, including increased human presence on the site, and construction of facilities, infrastructure and transmission lines.

Prior to construction of any facilities or infrastructure, geotechnical investigations would need to be conducted to ensure that any construction can withstand strong seismic events.

Subsidence can occur where groundwater is pumped from underground aquifers at a rate exceeding the rate that it is of replenished. Most of the geothermal development includes reinjection of the geothermal fluid after the heat is utilized. Therefore, the potential for subsidence is low.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on geological resources and seismicity; however, cumulative effects of anticipated future actions could combine with identified nearby geothermal development to result in cumulative impacts on seismicity. These impacts are expected to be generally minor, provided that construction and operation of the proposed geothermal plants, and all existing nearby structures that may be affected by seismic activity, will be and have been constructed in compliance with building codes and state and local permit requirements.

14.3.4 ENERGY AND MINERALS

Setting

The local utility company that provides electricity to the Tonopah, Gabbs and Round Mountain Area of Nye County is Sierra Pacific Power. Sierra Pacific Power's total service territory covers approximately 50,000 square miles in northern Nevada and the Lake Tahoe area of northeastern California. Currently, Sierra Pacific meets energy demand of its customer base through generating power at company owned power plants (approximately 2,800 megawatt) and purchasing energy in the market to meet excess demand. By 2015, Sierra Pacific expects that about 40 percent of their electricity will be produced using natural gas, 40 percent using coal and 20 percent from renewable energy, Currently, Nevada Power and Sierra Pacific Power get a portion of their power from 22 renewable energy sources, including geothermal, solar, hydro and biofuel resources (Sierra Pacific 2008).

Nevada's 2005 Renewable Portfolio Standards require that 20 percent of energy in the state by produced from alternative energy sources. This initiative has been supported by Sierra Pacific Power (Sierra Pacific 2008).

There is currently no extraction of leasable, locatable or salable resources occurring in the pending lease area. Locatable minerals have historically been a major source of industry in the region. Mineral produced include copper, gold, silver, molybdenum, lithium, fluorspar, bentonite clay, diatomaceous earth, mercury and turquoise (Bureau of Land Management 1994). Mining in the Humboldt-Toiyabe NF area is mainly associated with areas of historic gold and silver prospects, including the Reese River, Birch Creek, Big Creek, Kingston, Washington, Twin Rivers, and Jett mining districts (US Forest Service 1986). In the BLM Tonopah Resource Area there are 65 mining districts with a history of operation and 15 large mines operating as of 1994. In the pending lease area, BLM has identified the SW quarter of section 18 as having moderate potential for locatable minerals (Bureau of Land Management 1994).

Oil and gas development in the Tonopah Resource Area has primarily been limited to Railroad Valley. As of 1994, 160 wells had been drilled in the area and seven producing fields had been discovered (Bureau of Land Management 1994). Additional areas with moderate to high potential for oil and gas minerals are identified in the Tonopah RMP; none are within or adjacent to the pending lease area.

Additional Geothermal resources are found in the region. In the BLM Tonopah Resource Area, two additional known geothermal resource areas have been identified at Round Mountain and Fish Lake Valley. The Round Mountain known geothermal resource area has been developed by the Round Mountain Gold Corporation, who uses the geothermal energy to for direct-use at the Round

Mountain Gold Mine. At Fish Lake Valley known geothermal resource area, a permit for a 5 megawatt plant was issued in 1987. Sale of power has been contracted to Southern California Edison (Bureau of Land Management 1994).

Darrough hot springs in the northern portion of the pending lease area had been drilled and flow tested prior to the release of the Tonopah RMP in 1997 (Bureau of Land Management 1997). The pending noncompetitive lease application was filed by Lillian Darrough, owner of Darroughs Hot Springs, in 2001 in partnership with Great American Energy.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on energy and mineral resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on energy or mineral resources; however, anticipated future actions likely to follow leasing would likely result in the use of a currently unused geothermal resource and would contribute a renewable form of energy to the power grid. The Reasonably Foreseeable Development scenario predicts that one 12 megawatt binary power plant will be developed in the pending lease area for electricity generation.

General impacts of geothermal development on energy and minerals for a standard 50 megawatt plant are discussed in detail in Section 4.4 of the PEIS. Impacts in the pending lease area would be similar to those described in the PEIS but at a reduced level due to the smaller capacity of the power plant likely in this area. Geothermal development would allow existing geothermal resources in the area to be utilized and would contribute a renewable source of energy to the local and regional power grid. The Proposed Action could potentially contribute to the State of Nevada Renewable Portfolio Standard.

Development could also prevent other energy sources from being developed or minerals from being extracted in the immediate lease area.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on energy and minerals; however, the geothermal development activities likely to follow leasing could contribute to cumulative energy and mineral impacts in the Smoky Valley and Nye County. Cumulative impacts limiting the extraction of other energy sources or minerals from being extracted are expected to be minimal due to the large expanses of undeveloped lands in the region.

14.3.5 Soil Resources

Setting

Soils in the pending lease area are dominated by Wrango stony fine sandy loam. This soil type is formed in stone or boulder overlying mixed alluvium, composed of no greater than five percent Calcium carbonate. Slopes of this soil type are typically two to eight percent. The soil is excessively drained, with a moderately high to high capacity to transmit water, and a low frequency of flooding. This soil type is intermixed along the east side of the proposed lease site with low quantities of silt and clay loams, which have a moderate-to-high available water capacity compared with the dominant soil type (Natural Resources Conservation Service 2008b).

There is no prime or unique farmland within the proposed lease site.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on soil resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on soils; however, anticipated ground disturbance from the geothermal exploration and development activities likely to follow leasing would potentially result in impacts on erosion and soil productivity. Potential impacts on soil resources from geothermal development are described in Chapter 4 of the PEIS.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on soils in the lease area; however, anticipated future actions associated with development of geothermal resources could contribute to cumulative soil impacts. The cumulative effects on soil resources of anticipated actions following leasing, combined with other nearby geothermal development, are expected to be minor provided that construction and operation of all geothermal plants and ancillary facilities are in compliance with building codes, and state and local permit requirements.

14.3.6 Water Resources and Quality

Setting

Surface Water

The pending lease area receives approximately 5 inches of precipitation per year (Western Regional Climate Center 2000). The site is traversed by three unnamed intermittent streams flowing down from the Toiyabe Mountains to the west, one stream that is fed by springs to the northeast of the proposed lease site, and one aqueduct. There are no springs within the proposed lease site, although there are several springs within 0.5 mile of the site to the east and the south, including Darroughs Hot Springs at 0.5 mile to the east, several unnamed springs directly adjacent to the pending lease area to the east, and several unnamed springs just south of Wineglass Ranch, approximately 0.5 mile to the south of the site.

The quality of Nye County's surface water is in compliance with the 1972 Clean Water Act. Vulnerability assessments conducted for public water supply systems did not identify any contamination of surface water drinking sources in the County. The key issues related to the surface water resources of Nye County are the protection of spring and stream discharge rates, the management and use of riparian areas, and the maintenance of surface water quality. Spring and stream discharges in Nye County may be reduced by diversions for beneficial use (a permitted activity), drought (a natural condition), or the effects of groundwater pumping that is located too near to surface water bodies. The Nye County Water Resources Plan highlights how surface springs may be affected by groundwater pumping (Nye County 2004).

Key surface water management issues in Nye County include:

- Conservation;
- Relationships between surface and ground water uses;
- Interstate and inter-county management and use;
- Water use measurement and estimation;
- Nonpoint source pollution;
- Meeting recreational demands; and
- Maintenance of instream flows (Nye County 2004).

Ground Water

This proposed lease site lies within the Humboldt River Basin, in the Great Basin Hydrologic Region. The Great Basin region is an arid region located in the rain shadow of the Sierra Nevada Mountains. The region is characterized by northerly trending mountain ranges and intermountain valleys with closed drainage. None of the streams that originate within this basin have an outlet to the ocean. The Great Basin's internal drainage results from blockage of water movement by high fault-created mountains and lack of sufficient water flow to merge with larger drainages outside of the Great Basin.

The Humboldt River Basin covers approximately 10,780,000 acres in multiple counties and contains the largest river (Humboldt River) wholly contained within Nevada. The basin includes 34 hydrographic areas and one hydrographic sub-area. It originates in the Ruby, Jarbidge, Independence, and East Humboldt Mountain ranges and terminates in the Humboldt Lake and Sink (Nevada

Department of Conservation and Natural Resources 2008). Average flow of the Humboldt River is approximately 195,000 acre-feet per year. The Humboldt River Basin contains most of the active gold mines in northern Nevada, several of which have extended below local groundwater levels (US Geological Survey 1996) and contaminants from mining activity are a major factor affecting water quality. Much of the groundwater is diverted for irrigation of agricultural land (US Geological Survey 2008b).

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on water resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on water resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts.

Typical impacts on water quality from geothermal development are described in Chapter 4 of the PEIS under Water Resources. Best management practices addressing stormwater are included in Appendix D of the PEIS and would reduce impacts on surface water quality.

Indirect use geothermal projects require large amounts of water during all phases of a project from exploration through closeout; therefore, anticipated actions following leasing under the Proposed Action could result in impacts on the local groundwater table, which could affect the nearby surface springs that are near the proposed lease site. The potential for impacts on springs depends upon the proximity of the pumping, the hydraulic characteristics of the aquifer, and the magnitude and duration of pumping. Lease stipulations for this site are recommended to include monitoring of groundwater levels and of flow rates at the nearby springs.

Geothermal waters and groundwater rights would need to be appropriated through the Nevada Division of Water Resources, which would assess impacts on local groundwater supply.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on water resources in Smoky Valley; however, anticipated future actions associated with development of geothermal resources nearby could contribute to such impacts. The geothermal developments could cumulatively impact surface water quality through ground disturbance and stormwater runoff. Groundwater quality could be cumulatively impacted through onsite spills of petroleum products and other chemicals used during construction and maintenance of facilities. Lease stipulations identified in Chapter 2 and best management practices in Appendix D of the PEIS would reduce these potential cumulative impacts.

Cumulative impacts on groundwater supply would be expected due to the large volumes of water required for all stages of geothermal development.

14.3.7 AIR QUALITY AND ATMOSPHERIC VALUES

Setting

The pending lease area is located in Nye County, an area with air quality status of Unclassified. Due to the remote location of the proposed lease site, air quality is generally considered to be good, except during wind/dust storms when levels of particulate matter are high.

The principal climatic features of the pending lease area are bright sunshine, small annual precipitation, (averaging five inches per year), clean, dry air, and exceptionally large daily ranges of temperature. The closest weather monitoring station to the proposed lease site is in Tonopah. Average maximum temperatures in Tonopah range from 39.9 degrees Fahrenheit in January, to 87.8 in July, with average minimum temperatures ranging from 22.4 degrees Fahrenheit in January, to 61.4 in July (Western Regional Climate Center 2000).

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on air quality and atmospheric values.

Alternative B (Proposed Action)

The Proposed Action alternative would not have any direct impact on air quality or atmospheric values. Anticipated geothermal exploration and development activities likely to follow leasing would not result in violations of ambient air quality standards given the Unclassified status of the county and the good air quality of the area; however, such anticipated actions could result in minor air quality impacts, as described in Section 4.8 of this PEIS.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on air quality in Nye County; however, the anticipated future actions following leasing could contribute to cumulative air quality impacts. Construction-related dust and diesel exhaust would be realized from the exploration and drilling operations and development phases of geothermal development, as well as all from other identified cumulative actions. These cumulative impacts would be temporary and would only occur if cumulative actions were occurring at the same time.

Cumulative air quality impacts during the utilization phase of a geothermal project would be limited to vehicle travel of operation and maintenance staff, and the occasional well venting, flow testing, and blowouts. Emissions from these activities would cumulatively contribute to a degradation in air quality in Nye County.

14.3.8 VEGETATION

Setting

The lease area is within the Great Basin, which has hot summers and cool dry winters. The vegetation occurring is well adapted to climactic extremes. The vegetation is sparse, but plays a critical role in ecosystem function, providing cover for wildlife from the elements and from predators. The pending lease areas are located within the Big Smoky Valley which is found in the Intermountain and Mountain Semi-desert and Desert ecoregion province (See Appendix G). This province makes up much of the Great Basin. Average maximum temperatures range from 43 degrees Fahrenheit (˚F) in January to 91 ˚F in July. Precipitation comes equally as snow and rain for an annual average of five inches in the lease area (Western Regional Climate Center 2000).

The plant community sagebrush scrub dominates the area. Other important plants in the sagebrush belt are antelope bitterbrush (*Purshia tridentate*), shadscale *(Atriplex confertifolia)*, fourwing saltbush *(Atriplex canescens)*, and rubber rabbitbrush (*Chrysothamnus nauseosus*). All these shrubs tolerate alkali to varying degrees, essential to their survival on the poorly drained soils widespread in the Great Basin. On soils with the highest concentrations of salt, even these shrubs are unable to grow; they are replaced by plant communities dominated by greasewood (*Sarcobatus* spp.) or saltgrass (*Distichlis spicata var. stricta*). Other plant communities found in the lease areas are the creosote bush scrub, iodine bush scrub, saltbush scrub (Bailey 1995).

Sagebrush Scrub

Sagebrush scrub is a treeless community of low shrubs stretching across much of the high desert (4,000 to 9,000 feet) and also within the montane forest. It is widely distributed in the Big Smoky Valley. Characteristic species include Great Basin sagebrush (*Artemesia tridentata)*, rubber rabbitbrush, and antelope bitterbrush. Native bunch grasses, such as Great Basin wildrye (*Leymus cinereus*), Idaho fescue (*Festuca idahoensis*), and bluebunch wheatgrass (*Pseudoroegneria spicata*), have been affected by livestock grazing and largely replaced by native perennials and introduced annual grasses. The understory of this community is often sparse due to the harsh climate and difficult growing conditions (Barbour and Billings 1988, Natural Resources Conservation Service 2008a).

Creosote Bush Scrub

Creosote bush scrub is common in the lease areas (US Forest Service 1998). This plant community typically occurs on well-drained secondary soils of slopes, fans, and valleys. This habitat type is generally characterized by relatively barren ground with wide-spaced shrubs. Common plants include pure stands of creosote bush *(Larrea tridentate)* or mixed shrubs, including species of burrobush/white bursage *(Ambrosia dumosa)*, brittlebush *(Encelia farinosa)*, ocotillo *(Fouquieria splendens)*, and saltbushes *(Atriplex* spp.*)* (Sawyer and Keeler-Wolf 1995). Less abundant species may include desert-holly *(Atriplex hymenelytra)*, ephedras *(Ephedra* spp.*)*, box-thorns *(Lycium* spp.*)*, prickly-pears *(Opuntia* spp.*)*, and indigo bush *(Psorothamnus schottii)*.

Iodine Bush Scrub

Iodine bush scrub is mainly characterized by iodine bush (*Allenrolfea occidentalis*) and occurs around the margin of the Salton Sea. Other species within this community are seepweed (*Suaeda moquinii*), pickleweed (*Salicornia subterminalis*), and alkali heath (*Frankenia salina*).

Saltbush Scrub

Saltbush scrub is common in the valley (Resource Concepts Inc. 2008). This series is a temperate, broad-leaved, evergreen shrubland with common species that include fourwing saltbush, shadscale, big saltbush *(Atriplex lentiformis)*, and allscale *(Atriplex polycarpa)* (Sawyer and Keeler-Wolf 1995).

Invasive Species

Invasive species include any species that are not native to that ecosystem and includes plants or animals that have been introduced into an environment where they did not evolve. Invasive species can have dramatic impacts on the natural ecosystem by reducing habitat for native vegetation, as well as, altering forage and wildlife habitat. Invasive species reduce the productivity of healthy rangelands, forestlands, riparian areas, and wetlands. Invasive species can also change the fire regime, typically increasing the intensity and occurrence of fires. Eradication of these species is intensive, time consuming, and costly (Bureau of Land Management 2008).

Numerous exotic grasses and plants, like perennial pepper weed *(Lepidium latifolium),* annual medusahead (*Taeniatherum caput-medusa*), red brome (*Bromus rubens*), and various non-native thistles, have displaced native plants and altered local plant communities in the Great Basin (Bureau of Land Management 2008). Cheatgrass (*Bromus tectorum*) has had a particularly dramatic impact on native shrub and grassland communities of the Great Basin (Bureau of Land Management 2008). Cheatgrass displaces native grasses and forbs by more effectively tapping soil moisture and hinders seedling establishment of native shrubs by reducing moisture and nutrients in surface soils (Norton et al. 2004).

Wetlands/Riparian Areas

Freshwater emergent wetlands are found on the eastern side of the lease area as several geothermal springs rise to the surface and saturate the soil (US Fish and Wildlife 2008a). Willows (*salix* spp.) and rush (*Scirpus* spp.) are present.

Impacts

Potential impacts on vegetation and important habitats could occur if reasonably foreseeable future actions were to:

- Affect a plant species, habitat, or natural community recognized for ecological, scientific, recreational, or commercial importance;
- Affect a species, habitat, or natural community that is specifically recognized as biologically significant in local, state, or federal policies, statutes or regulations;
- Establish or increase of noxious weed populations;
- Destroy or extensively alter habitats or vegetation communities in such a way that would render them unfavorable to native species; or
- Conflict with BLM or FS management strategies.

Alternative A (No Action)

The No Action alternative would have no impact on vegetation.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on vegetation or important habitats or communities; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in impacts associated with the elimination and degradation of habitat. Geothermal activities can cause the following stressors and which may result in associated indirect impacts on vegetation and important habitats:

- Habitat disturbance – Site clearing, well drilling, construction of access roads and geothermal facilities, as well as maintenance and operational activities would disturb habitat which in turn could cause mortality and/or injury to plants, an increased risk of invasive species colonization, and alter water and seed dispersion, as well as affect wildlife use, which can further affect vegetation communities.
- Direct Removal and Injury – Vegetation would be cleared for roadways, vehicle staging, buildings, pipelines, and transmission lines. These activities could result in loss of soil, loss of seed bank in soil, deposition of dust, and destruction of biological soil crusts. Maintenance around project components, such as drill pads, buildings, pipelines, or other facilities would involve mowing, herbicide treatment, and other mechanical or chemical means of removal and control of plant life. This would in turn result in a net loss of important habitats and communities throughout the planning area.

- Invasive Vegetation – Disturbance and access by vehicles and human foot traffic may expose areas to colonization by invasive and non-native species, making it more difficult for endemic species to reestablish in disturbed areas as well as threatening the continued existence of endemic species.
- Fire – Increased vehicular and human traffic, operation of equipment, and the extraction of geothermal fluids can increase the risk of fires. Vehicles, electrical lines, and cigarette smoking can all result in accidental fires. Fires destroy vegetation and can aid in the establishment of invasive species.
- Erosion – Site clearing, grading, construction of access roads, containment basins, site runoff, and vehicle and human foot traffic cause erosion. The effects of erosion include the removal of top soil, loss of seed bank, loss of native vegetation, the establishment of invasive species, the sedimentation of streams, and flooding (which can directly result in effects to riparian vegetation and riparian habitats).
- Exposure to Contaminants – Vehicle fuel, hydraulic fluid, solvents, cleaners, and geothermal fluids can all be harmful to vegetation and important habitats. Accidental spills can contaminate soils and water and directly harm vegetation. Licensed herbicide use would likely be used to control vegetation around geothermal facilities and support structures. Spills of herbicides or acute exposure to herbicides can have adverse affects on non-target vegetation.

Table 3.9-1 in Section 3.9 of the PEIS provides an analysis of the likelihood for impacts to occur during each phase of geothermal development (exploration, development, production, and close out).

Riparian and Wetland Habitat

Development of geothermal facilities and structures and the pumping and extraction of groundwater for drilling operations and/or geothermal fluids could affect the wetlands and riparian areas within the lease area, as well as wetlands and riparian habitat with a hydrological connection to the lease area or to the groundwater extracting during drilling operations. Wetlands could be filled or destroyed to provide for roadways and infrastructure, and groundwater tables may be lowered, which could affect ground springs and desiccate wetlands. The PEIS provides more specific detail on the impacts on riparian and wetland habitats associated with geothermal activities. Impacts on wetlands are regulated under the River and Harbors Act and Section 404 of the Clean Water Act. Permitting from the U.S. Army Corps of Engineers (Corps) will be required if future development at the site will have any impact to wetlands under the Corps' jurisdiction. In addition, E.O. 11990, "Protection of Wetlands," requires all federal agencies to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. DOE implementation of this E.O. is included in 10 CFR 1022.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on vegetation and important habitats in the lease area; however, anticipated future actions associated with development of geothermal resources could contribute to cumulative impacts on vegetation and important habitats in the Smoky Valley. Vegetation may be removed during exploration and drilling operations and development phases of a geothermal project along with the nearby geothermal activities. In areas where vegetation is removed, short-term, potential infestation of invasive weed species could occur. By complying with lease stipulations and best management practices outlined in Chapter 2 and Appendix D, respectively, cumulative impacts on vegetation would be reduced.

14.3.9 FISH AND WILDLIFE

Setting

Fisheries

The Big Smoky Valley speckled dace (*Rhinichthys osculus lariversi*) and the endemic Big Smoky Valley tui chub (*Gila bicolor spp.*) may be found in the streams and pools that exist as a result of the geothermal springs found on the eastern side of the lease area (Nevada Natural Heritage Program 2008). The speckled dace is a small minnow (usually less than 2 inches long) with a robust elongate body. It typically inhabits rocky riffles, runs and pools of headwaters, creeks and small to medium rivers, as does the chub (Fishbase 2008).

Wildlife

Animal abundance and diversity are closely linked with the habitat types present, though abundance and distribution may vary by seasons. The inhospitable habitat conditions limit the number, type, diversity, and abundance of species in the lease area.

Desert animals are well adapted to survive under these extreme environmental conditions found in the lease area. Extensive root systems of desert plants provide access to subsurface openings for lizards, snakes, and small mammals. Common mammal species include mule deer (*Odocoileus hemionus*), black-tailed jackrabbits (*Lepus californicus*), coyote (*Canis latrans*). Other species that have the potential to occur are badger (*Taxidea taxus*) and bobcat *(Lynx rufus*). Several small mammals are found in the area. They include the desert pocket mouse (*Perognathus* spp.) and desert kangaroo rat (*Dipodomys deserti*). Many other small wildlife species may create burrows in open areas to escape the heat or predator.

Bird species that may occur include Gambel's quail (*Callipepla gambelii)*, mourning dove (*Zenaida macroura*), red-tailed hawk (*Buteo jamaicensis*), golden eagles (*Aquila chrysaetos*), peregrine (*Falco peregrinus)*, prairie falcons (*Falco mexicanus*), and American kestrel (*Falco sparverius*). Numerous waterfowl of the Pacific Flyway pass through the area during migration and likely use the pools and wetlands created by the geothermal springs as a stop over area for foraging and resting.

Nevada is home to over 50 reptile species and the lease area has habitat for numerous reptile species. These include the following: Great Basin western rattlesnake (*viridis lutosus),* Great Basin gopher snake (*Pituophis catenifer* deserticola*),* terrestrial garter snake *(Thamnophis elegans*), western aquatic garter snake (*T. couchii*), Great Basin collared lizard (*Crotaphytus bicinctores*), leopard lizard (*Gambelia wislizenii*), and western fence lizard (*Sceloporus occidentalis*), among others (Morefield 2008). Several amphibians, such as the Great Basin spadefoot toad (*Spea intermontana*), are likely to occur in the lease area.

Impacts

Potential impacts on fish and wildlife species could occur if reasonably foreseeable future actions were to:

- Adversely affect a population by substantially reducing its numbers, causing a fish or wildlife population to drop below self sustaining levels, or by causing a substantial loss or disturbance to habitat utilized by a fish or wildlife population. Examples of such habitat effects could include vehicle impacts and crushing, increased predation, habitat fragmentation, or loss of seasonal habitat;
- Have a substantial adverse impact on nesting migratory birds, including raptors, as protected under the Migratory Bird Treaty Act;
- Interfere with the movement of any resident or migratory fish or wildlife species, or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites; or
- Conflict with the wildlife management strategies of the BLM or FS.

Alternative A (No Action)

The No Action alternative would have no impact on fish and wildlife.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on fish and wildlife; however, anticipated geothermal exploration and development activities following leasing would potentially result in such impacts, as described below. The Big Smoky Valley speckled dace, as well as other aquatic biota, could be at risk of being affected by geothermal activities on the lease site. Activities that affect riparian and wetland habitats in the area may directly affect aquatic life. These activities could cause sedimentation, increased water temperature, lowered water levels, exposure to contaminants such as herbicides or fuels, and may directly affect habitat through the construction of roadways, facilities, or structures.

Terrestrial wildlife species could be displaced during the removal of habitat or development of geothermal facilities. Small ground dwelling species, such as reptiles and small mammals, could be crushed either by vehicle traffic and/or clearing activities. Fire can also cause direct mortality. Vehicles, cigarette smoking, and power lines can cause wildfires that can kill and displace animal species, especially smaller and less mobile animals. Invasive vegetation introduced during exploration and development activities can also alter wildlife habitat, making it less suitable for habitation.

The PEIS provides a detailed discussion of the impacts that may occur to fish and wildlife as the result of geothermal activities.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on fish and wildlife; however, anticipated future actions associated with development of geothermal resources would contribute to cumulative impacts on fish and wildlife in the Smoky Valley area. Construction activities, such as grading, digging, and the use of heavy vehicles, could cumulatively result in disturbing wildlife when combined with other cumulative actions. Habitat could also be lost under the impacts of the anticipated future actions following leasing and the other nearby geothermal projects.

14.3.10 Threatened and Endangered Species and Special Status Species

Setting

This section provides an overview of threatened, endangered, and special status species, and their habitats that may occur in the lease area. Special status species are those identified by federal or state agencies as needing additional management considerations or protection. Federal species are those protected under the Endangered Species Act and those that are candidates or proposed for listing under the Endangered Species Act. State sensitive species are those considered sensitive by the Nevada Department Wildlife. The Nevada Natural Heritage program NFS biologists, and US Fish and Wildlife Service species lists were consulted to assess the potential for sensitive species in the area.

A species of particular concern that may be present is the pygmy rabbit (*Brachylagus idahoensis*). Pygmy rabbits are typically found in areas of tall, dense sagebrush (*Artemisia spp.)* cover, and are highly dependent on sagebrush to provide both food and shelter throughout the year. Their diet in the winter consists of up to 99 percent sagebrush (US Fish and Wildlife Service 2008b). The Nevada population of Pygmy rabbit is not listed under the Endangered Species Act, but the United States Fish and Wildlife Service is currently reviewing whether or not the species warrants formal listing under the ESA (US Fish and Wildlife Service 2008c).

The sagebrush habitat found in the lease areas may provide quality habitat for greater sage-grouse (*Centrocercus urophasianus*). Greater sage-grouse have experienced long-term declines due to the degradation and loss of important sagebrush-steppe and grassland habitats (BLM 2005b). Greater sage-grouse require contiguous, undisturbed areas of high-quality habitat during their four distinct seasonal periods of breeding, summer-late brooding and rearing, fall, and winter (Connelly et al. 2004). Sagebrush is important to the greater sage-grouse for forage and for roosting cover, and the greater sage-grouse cannot survive where sagebrush does not exist (Connelly et al 2004). The greater sage grouse is not formally listed under the ESA, but it is a FS sensitive species and has been proposed for listing. The BLM and FS have developed the Sage-Grouse Habitat Conservation Strategy to manage public lands in chorus with other agencies in a manner that will maintain, enhance, and restore greater sage-grouse habitat while providing for multiple use (Bureau of Land Management 2004). The strategy is consistent with Nevada sage-grouse conservation planning efforts.

The only special status fish species known to occur in the lease area is the Big Smoky Valley speckled dace. The fish may be present in the riparian stream and wetland areas found on in the eastern portion of the lease area. The fish is a Nevada species of concern (Nevada Natural Heritage Program 2008).

Impacts

Potential impacts on threatened and endangered and special status species could occur if reasonably foreseeable future actions were to:

- Violate the Endangered Species Act, the Migratory Bird Treaty Act, the Bald and Golden Eagle Protection Act, or applicable state laws; or
- Decrease a plant or wildlife species population to below self-sustaining levels.

Alternative A (No Action)

The No Action alternative would have no impact on special status species.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on threatened and endangered and special status species; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Threatened and endangered, and special status species, including the Big Smoky Valley speckled dace, could be affected as a result of 1) habitat disturbance, 2) the introduction of invasive vegetation, 3) injury or mortality, 4) erosion and runoff, 5) fugitive dust, 6) noise, 7) exposure to contaminants, and 8) interference with behavioral activities.

Because of the regulatory requirements of the Endangered Species Act and various state regulations, and the requirements specified in BLM Manual 6840 Special Status Species Management, and other resource-specific regulations and guidelines, any future geothermal activities would incorporate appropriate survey, avoidance, and mitigation measures. These measures would be identified and implemented prior to any geothermal activities in order to limit any adverse affects to Big Smoky Valley speckled dace or to any other special status species which either may be found or were expected to occur in the lease area at the time of the survey.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on special status species in the region; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Loss of habitat from all aspects of development is a major factor contributing to the increase in the number of species listed as threatened or endangered. Future development in the lease areas would be limited to small areas and disturbance would be temporary. Cumulative impacts are not likely to adversely affect special status species in the lease area.

Roads contribute to the cumulative impacts within a region. Existing roads would be used where possible for future development; however, improvements to existing roads and construction of new roads would likely be needed for future projects following leasing, as well as for nearby geothermal projects.

14.3.11 CULTURAL RESOURCES

Setting

Cultural resources are past and present expressions of human culture and history in the physical environment and include prehistoric and historic archaeological sites, structures, natural features, and biota that are considered important to a culture, subculture, or community. Cultural resources also include aspects of the physical environment that are a part of traditional lifeways and practices and are associated with community values and institutions.

As in the PEIS, discussions relevant to cultural resources in this document are found in three sections. Traditional cultural resources and traditional cultural properties are addressed in Section 14.3.13 Tribal Interests and Traditional Cultural Resources. Cultural resources in this section include the physical remains of prehistoric and historic cultures and activities.

The subject lease areas are contained within the Great Basin culture region, as described broadly in the Appendix I of the PEIS. Bengston (2003) provides a comprehensive ethnographic overview of the project area within this larger culture region. The following discussion is based on that overview. As outlined in Appendix I, the earliest people to inhabit this area are referred to as Paleoindian, Archaic, and Fremont cultures. Little is known about these groups. Bengston places the project area near the western territorial boundary of the Western Shoshone (Bengston 2003). It is believed that the Western Shoshone entered the Great Basin approximately 1,000 – 5,000 years ago, most likely from the west. The Western Shoshones remained in the area and are one of the Native American groups encountered by historic European explorers. The prehistoric group is categorized as a hunting and gathering group, subsisting on plant gathering and hunting of game. They were highly mobile, utilizing temporary and easily-constructed structures. Winter camps were established in the same general areas year to year with temporary camps established throughout territorial areas for the purposes of hunting and gathering. One winter camp is documented in the Big Smoky Valley near the project area (Bengston 2003). Other structures built by the Western Shoshone included gabled houses, conical-shaped sweat, lodges, sun shades, windbreaks, and pine nut caches. Rockshelters and caves were also used as temporary shelters.

A variety of historic-era activities have been documented within the region of the proposed project. These included fur trapping during an initial period of Euro-American exploration, emigration and settlement by Euro-Americans, establishment of wagon roads and later freight roads and railroads, mining, and agriculture. Fur-trapping potential was always marginal in the Great Basin, and expeditions ended in the early 1840s. As fur trapping declined, official government mapping and exploration expeditions were expanded into the Great Basin, partially to establish an American presence in what was, until 1848, Mexican territory. Later, several trails were established by emigrants, most passing through the state to California during the Gold Rush and establishment of the Comstock. Some of the first permanent settlements of Nevada were established along those trails. The new population centers and mineral discoveries gave rise to regional wagon road networks connecting markets to supply points and mineral sources to mills. Many of the initial roads ran east-west for delivery to California, but with the completion of the transcontinental railroad along the Humboldt River corridor in 1869, freight roads running north-south linking railheads with interior mining districts began to be established. Some wagon road networks were expanded and developed into Nevada's federal highway system as the state continued to develop into its modern form. The importance of mining in Nevada's economy faded between 1880 and 1900 as no new discoveries were made and areas that had been developed in connection with mining declined (Bengston 2003; Pendleton et al. 1982).

In 1871, the Army relinquished Camp McGarry near Summit Springs and it was turned over for use as the first reservation for Northern Paiutes and Western Shoshones. It is now known as the Summit Lake Indian Reservation. Some Western Shoshone however were still living on lands rented from Euroamerican farmers. In 1877, reservations began to be established for some of the Western Shoshone bands in Nevada by the US through Executive Order at Duck Valley and Carlin Farms, both in northern Nevada. The Carlin Farms Reservation lasted only two years and although some Western Shoshone relocated to the Duck Valley Reservation, some refused to move from their traditional territories. Over time, additional reservations were established throughout the state. These are documented in Table 3.1 of Bengston (2003). The nearest reservation to the project area is the Yomba Shoshone Reservation on the west side of the Toiyabe Range (Bengston 2003).

Data on cultural resources of the proposed lease area were gathered from the Nevada Cultural Resource Information System in April 2008. Consultations with interested parties, including local tribes and historic preservation groups, have not been initiated. Consultation with the Nevada State Historic Preservation Office has not been initiated yet either.

Less than ten percent of the project area has been previously surveyed. Six cultural resource sites have been previously documented within one mile of the project area. Five are outside of the project area and include four isolated lithic artifacts and a prehistoric campsite. It is unknown if any of these resources have been evaluated for the National Register of Historic Places; they are assumed here to be unevaluated. The sixth site, NY4294, has been recorded as extending into the southern quarter of the project area. It is described as an extensive campsite with dispersed pieces of debitage evident on the ground surface. In 2003, the most recent recorder believed there may be buried artifacts within the site boundaries due to low-energy sheetwash deposition of sand, silt, and clay. The dispersed nature of surface artifacts and the large size of the site suggest that it was used for a series of small field camps. However, it is also noted that much of the surface artifact assemblage has likely been removed by looters. Post-1950s trash dumps still being used today are adjacent to several roads in the southern part of the site. The site as a whole was recommended as ineligible for the National Register of Historic Places.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on cultural resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on cultural resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Completion of the Section 106 process of the National Historic Preservation Act requires the BLM and FS to consult with the State Historic Preservation Office, tribes and other parties to identify and assess historic properties affected by the undertaking and develop measures to avoid, minimize, or mitigate any adverse effects of the undertaking on historic properties.

Given the density of sites within the surrounding areas of the Humboldt-Toiyabe lease area and general lack of previous surveys covering the lease area itself, indirect and secondary impacts on cultural resources could occur from subsequent permitted geothermal exploration, development, production and closeout through ground-disturbing activities, unauthorized actions and alterations to setting and cultural landscapes. The nature of these impacts is described in Chapter 4 of Volume I of the PEIS. Additionally, as described in Chapter 2 of Volume I of the PEIS, various areas of cultural resources would have No Surface Occupancy stipulations: National Landmarks, National Register Districts, National Register of Historic Places (NRHP)-listed and -eligible sites and their associated landscapes, traditional cultural properties, Native American sacred sites, and areas with important cultural and archaeological resources. Areas of potential effect would include access roads, well pads, power plant footprints, pipeline and transmission line routes, and construction staging areas as well as the boundaries of cultural resources those facilities cross and the aspects of setting that contribute to significance. These areas of potential effect would be developed at the project-specific level, and would require inventories, evaluations, and appropriate treatments as outlined in the best management practices of Appendix D in Volume III of the PEIS. Under these cultural resources best management practices the BLM would also conduct Section 106 consultations with the State Historic Preservation Office, Native American tribes with ties to the lease area, and local historic preservation groups to identify the presence and significance of cultural resources within or adjacent to the lease area and assess the level of impact of geothermal exploration and development on those resources. Project-specific impacts from actions anticipated following leasing would be reduced by implementing these best management practices.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on cultural resources; however, anticipated future actions associated with development of geothermal resources could cause such impacts. Past ground-disturbing activities and the project identified in Section 14.1.4, *Cumulative Projects*, undoubtedly have and will have effects on cultural resources given the regional density of resources and general lack of terrestrial survey coverage. Presumably past activities would have mitigated impacts to less than significant through re-design, data recovery, or other similar methods. Any effects from the anticipated future actions following leasing would be mitigated to less than significant through implementation of best management practices during the permitting process.

14.3.12 Tribal Interests and Traditional Cultural Resources

Setting

Tribal interests include economic rights such as Indian trust assets, and resource uses and access guaranteed by treaty rights. Traditional cultural resources or properties include areas of cultural importance to contemporary communities, such as sacred sites or resource gathering areas. While most commonly considered in the context of Native Americans and Native Alaskans, there are traditional cultural resources associated with other ethnic or socially linked groups.

The subject lease areas are contained within the Great Basin culture region, as described broadly in the Appendix I of the PEIS. Bengston (2003) provides a comprehensive ethnographic overview of the project area within this larger culture region. Bengston places the project area near the western territorial boundary of the Western Shoshone. The Western Shoshone considered several springs significant traditional locations for ceremonies (Bengston 2003).

During the historic period several attempts were made to move Native American populations of Nevada to out-of-state reservations and other, more successful attempts were made to move some groups to in-state reservations. In 1871, the Army relinquished Camp McGarry near Summit Springs and it was turned over for use as the first reservation for Northern Paiutes and Western Shoshones. It is now known as the Summit Lake Indian Reservation. Some Western Shoshone however were still living on lands rented from Euroamerican farmers. In 1877, reservations began to be established for some of the Western Shoshone bands in Nevada by the US through Executive Order at Duck Valley and Carlin Farms, both in northern Nevada. The Carlin Farms Reservation lasted only two years and although some Western Shoshone relocated to the Duck Valley Reservation, some refused to move from their traditional territories. Over time, additional reservations were established throughout the state. The nearest reservation to the project area is the Yomba Shoshone Reservation on the west side of the Toiyabe Range (Bengston 2003).

Data on Tribal Interests and Traditional Cultural Resources of the proposed lease area were gathered from the ethnographic study of the Western Shoshone completed by Ginny Bengston (Bengston 2003). Bengston (2003) identifies several categories of traditional property types in Nevada including traditional origin and historic places, ceremonial locations, historical locations, ethnohistoric habitation sites, trails, burial sites, and resource collection areas. Of those culturally significant areas identified by the study, none are within Big Smoky Valley (Bengston 2003). It should be noted however, that locations of several of the areas were unknown to the researchers and could therefore not be mapped. Additionally, several concerns and issues of the Western Shoshone tribes are identified. These include concerns for culturally significant areas, the environment, land ownership, and the authenticity of ethnographic documentation of tribal information.

Consultation with federally recognized tribes that are affiliated with the lease area was initiated on September 12, 2007 to identify and assess tribal concerns and traditional resources that may be affected by the undertaking. No responses from the tribes have been received as of the date of publication. However, the consultation process is considered on-going. While many traditional cultural resources are well known, some locations or resources may be privileged information that is restricted to specific practitioners or clans. For tribes, maintaining confidentiality and customs regarding traditional knowledge may take precedence over identifying and evaluating these resources, unless they are in imminent danger of damage or destruction.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on tribal interests and traditional cultural resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on tribal interests and traditional cultural resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Impacts on tribal interests and traditional cultural resources are assessed using the criteria found in Chapter 4 of Volume I of the PEIS. Although no tribal interests or concerns have been identified by the consultation process, the process of Native American consultation is considered on-going and such resources may be identified in the future by tribes. Impacts on Tribal Interests would be minimized or avoided by implementing best management practices in Appendix D of Volume III of the PEIS for each of the phases of the Reasonably Foreseeable Development scenario as described in Chapter 2 of Volume I of the PEIS.

For traditional cultural resources, completion of the Section 106 process of the National Historic Preservation Act requires the BLM and FS to consult with the State Historic Preservation Office, tribes and other parties to identify and assess historic properties affected by the undertaking and develop measures to avoid, minimize, or mitigate any adverse effects of the undertaking on historic properties which includes traditional cultural properties. No Traditional Cultural Resources have been identified by consulted tribes thus far, but consultation is considered on-going. Additionally, archaeological resources such as those discussed in Section 14.3.11, *Cultural Resources*, are often considered traditional resources by tribes.

Impacts on traditional cultural resources could occur from anticipated future actions following leasing, such as exploration, drilling, utilization, and reclamation and abandonment through ground-disturbing activities, unauthorized actions and alterations to setting and cultural landscapes. The nature of these impacts and mitigations are described in Chapter 4 of Volume I of the PEIS. Areas of potential effect would include access roads, well pads, power plant footprints, pipeline and transmission line routes, and construction staging areas as well as the aspects of setting that contribute to significance. These areas of potential effect would be developed at the project-specific level, and would require inventories, evaluations, and appropriate treatments as outlined in the best management practices of Appendix D in Volume III of the PEIS. Under these cultural resources best management practices, the BLM and/or the FS would also conduct Section 106 consultations with the State Historic Preservation Office, Native American tribes with ties to the project area, and local historic preservation groups to identify the presence and significance of cultural resources within or adjacent to the lease area and assess the level of impact of geothermal leasing and development on those resources. Project specific impacts after leasing would be reduced by implementing these best management practices.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on tribal interests and traditional cultural resources; however, anticipated future actions associated with development of geothermal resources could cause such impacts. Past ground-disturbing activities and the project identified in Section 14.1.6, *Cumulative Projects*, may have effects on tribal interests and traditional cultural resources given the regional density of cultural resources and general lack of terrestrial survey coverage. Any effects from anticipated future actions following leasing would be mitigated to less than significant through implementation of best management practices during the permitting process.

14.3.13 Visual Resources

Setting

This section describes the visual resources in the region of influence, which is defined as the areas within and immediately surrounding the pending lease areas. Described below is the method for managing scenic resources and the visual landscape of the pending lease areas.

The BLM's Visual Resource Management System is a tool for inventorying and managing scenic resources, as well as analyzing potential impacts on visual resources. The scenery is managed using the Visual Resource Management system, described in the PEIS. All BLM lands within the lease site are in VRM Class IV, Modification.

The scenery of the Forest is managed through the application of the Visual Management System (Agricultural Handbook- 462, National Forest Landscape

Management, Volume 2, Chapter 1, The Visual Management System). The Visual Management System was adopted by the Forest Service in 1974. The key component of the Visual Management System is the establishment of Visual Quality Objectives within the Land and Resource Management Plan.

There are five differing levels of Visual Quality Objectives: Preservation, Retention, Partial Retention, Modification, and Maximum Modification. The following is a brief description of the five Visual Quality Objectives:

- Preservation – Allows ecological change only. Management activities are prohibited except for very low visually impacting recreation facilities.
- Retention – Management activities may not be visually evident. Contrasts in form, line, color and texture must be reduced during or immediately after the management activity.
- Partial Retention – Management activities must remain visually subordinate to the characteristic landscape. Associated visual impacts in form, line, color and texture must be reduced as soon after project completion as possible but within the first year.
- Modification – Management activities may visually dominate the characteristic landscape. However, landform and vegetative alterations must borrow from naturally established form, line, color or texture so as to blend in with the surrounding landscape character. The objective should be met within one year of project completion.
- Maximum Modification – Management activities including vegetative and landform alterations may dominate the characteristic landscape. However, when viewed as background they must visually appear as natural occurrences within the surrounding landscapes or character type. When viewed as foreground or middle ground, they may not appear to completely borrow from naturally established form, line, color, or texture. Alterations may also be out of scale or contain detail which is incongruent with natural occurrences as seen in foreground or middle ground. Reduction of contrast should be accomplished within five years.

The NFS lands portion of the pending lease site have Partial Retention and Modification Visual Quality Objectives.

The pending lease area is east of Cove Canyon in the Humboldt-Toiyabe NF and straddles State Route 376 just north of Carvers, Nevada, and approximately 8 miles north of Hadley, Nevada. Cove Canyon Road and a few other roads cross the area. The area is relatively flat and sloped. Portions of the pending lease area are in the Humboldt-Toiyabe NF and also on public land. With the exception of State Route 376, there are no sources of light in the pending lease areas.

According to the Humboldt-Toiyabe NF Land and Resource Management Plan, the area is typical of the Basin/Range landform in Nevada (US Forest Service 1998). Vegetation consists of pinyon/juniper, sagebrush types, aspen at higher elevations, and subalpine and alpine plant communities consisting of mountain mahogany, limber pine, and bristlecone pine. Although most of the moisture falls in the winter, intense summer thunderstorms and flash flooding are common occurrences.

According to the Proposed Tonopah Resource Management Plan and Final Environmental Impact Statement, visitors are attracted to the wide open spaces and vistas of the Tonopah Resource Area (Bureau of Land Management 1994). The Tonopah Resource Area has panoramic views of the topography, north-south trending mountain ranges, and intervening basins. The landscapes are dominated by flat playas, level basin fill plains, and long sloping alluvial fans which merge upwards into the mountains.

Impacts

Alternative A (No Action)

There would be no impacts on visual resources. There would be no changes to visual resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on visual resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. The potential risk of changes affecting visual resources is assessed for five significance criteria, which are described in the PEIS. Future actions based on the Reasonably Foreseeable Development scenario could result in changes that impact visual resources.

Future geothermal development activities could involve new structures, roads, and operations that are described in the reasonable development scenario. The new structures, roads, and operations would alter the characteristic landscape and be sources of light and glare. These impacts would be noticeable, because they would be in areas that are relatively undeveloped, would be readily visible due to topography and lack of obstructions, and would be near areas where recreation takes place. Best management practices outlined in Appendix B of the PEIS would minimize these impacts. It is assumed the stipulations would result in positioning new structures, roads, and operations in the landscape so they would remain visually subordinate to the characteristic landscape, and would result in landform and vegetative alterations that blend in with the surrounding landscape character. Therefore, changes to visual resources based on the reasonable development scenario would result in impacts on visual resources that would be consistent with Visual Resource Management Class IV objectives and Partial Retention and Modification Visual Quality Objectives.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on visual resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Anticipated actions likely to follow leasing, when combined with other nearby geothermal development activities, would increase the number of highly visible structures in the area. This would substantially reduce the natural undeveloped landscape of the area. These structures would be noticeable because they would not blend with the surrounding natural landscape. Sensitive receptors in the area could be negatively affected.

14.3.14 Socioeconomics and Environmental Justice

Setting

The leasing area covers approximately 606 areas within Nye County. Nye County was selected as the Region of Influence for socioeconomic analysis as the impacts of leasing are likely to occur within this region. A summary of the population, housing, employment, local school data and low-income and minority populations for the County is provided based primarily on data from Census 1990 and 2000 population, demographic and housing information (US Census Bureau 1990, 2000).

Population

Total population within the county was 42,693 in 2006 (US Census Bureau 2006), a more than 31 percent population increase over 2000 when the population was 32,485 and 114 percent increase over 1990 census numbers. Despite recent population increases, population density in the county remains low, at 1.8 people and 0.9 houses/square mile in 2000 (US Census Bureau 1990, 2000).

Housing

In 2000, the total number of housing units was 15,934, of which 13,309 were occupied and 10,167 were owner-occupied. The vacancy rate for homeowners was 3.4 percent and the rental property vacancy rate 17.9 percent. In 1990 there were 8,073 total housing units, 6,664 occupied and 4,677 owner-occupied, for a homeowner vacancy rate of 2.5 percent and a rental property vacancy rate of 12.1 percent (US Census Bureau 1990, 2000).

Employment

In 1999, the work force consisted of 13,263 people which 12,263 people were employed and 940 people (3.7 percent) of the population were unemployed. This is a decrease in unemployment from 1989, when the workforce consisted of 8,934 of which 8,256 were employed and 467, or 5.2 percent were unemployed.

Median household income in Nye County was $36,024 in 2000, a 16 percent increase over the median income of $30,211 in 1989. The median income remains lower than the state average which was $44,581 per household in 2000.

In 2000, the industries employing the greatest percent of the in Nye County were recreation, accommodation and food services (17.6 percent) educational health and human services (12.9 percent); construction (12.6 percent); and agriculture, forestry, fishing and hunting, and mining (10.1 percent) (US Census Bureau 2000).

Schools and Public Infrastructure

In 2000, 5,747 students were enrolled in K-12 in the Nye County. In 1990, 2,784 students were enrolled. There are approximately 17 students per teacher in the Tonopah School District which is comprised of 19 schools in the County. This ratio slightly lower than the state average of 19 students per teacher (National Center for Education Statistics 2006)

Environmental Justice

Based on 2000 data, 89.6 percent of the population in the county was White of non-Hispanic decent. The largest minority group in the area is Hispanic or Latino, which comprise 8.4 percent of the population. American Indians comprise approximately 2 percent of the population (US Census Bureau 1990, 2000). See Table 14.3-1, below for additional details.

Table 14.3-1
Population by Race/Ethnicity in Nye County

	1990	2000	Percent change
Total Population	17,781	32,485	+ 82.7 %
White/non-Hispanic	16,393	29,117	+ 77.6 %
Black/African American	291	383	+ 31.6 %
American Indian/Alaskan Native	499	636	+ 27 %
Asian	155	253	+ 63 %
Pacific Islander*	N/A	105	N/A
Other	443	969	+ 119 %
Two or more*	N/A	1,022	N/A
Hispanic or Latino**	1,237	2,713	+ 119 %

Source: US Census Bureau, 2000
* Not reported on1990 census: Asian and Pacific Islanders were one group and more than one race was not an option.
** In combination with other race. Totals may add to more than 100 percent as individuals can report more than one race.

In 1999, 10.7 percent of individuals were below the poverty level. Poverty levels have remained fairly stable despite dramatic population growth; in 1989, 10.5 percent of individuals polled were in poverty status (US Census Bureau 1990, 2000).

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on socioeconomics in Nye County's minority or low income populations because no ground-disturbing activities would be approved.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on socioeconomics or environmental justice; however, geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Impacts include a potential increase in jobs and decrease in unemployment in the Nye County due to construction and operations and maintenance jobs at newly developed geothermal plant. The Reasonably Foreseeable Development scenario is one plant at 12 megawatt. Due to small size of the plant, a large population influx is not anticipated; therefore impacts on schools and public infrastructure and housing would be minimal. Low income and minority populations are not likely to be impacted by geothermal development due to the lack of a residential population in and around the pending lease area. A detailed discussion of the impacts of geothermal leasing is found in Chapter 4 of the PEIS under *Socioeconomics and Environmental Justice*.

Cumulative Impacts

The Proposed Action would not have any cumulative impacts on socioeconomics and environmental justice; however, anticipated future actions associated with development of geothermal resources, in combination with nearby geothermal development, would be a positive stimulus to the local economy through both tax revenues for Nye County, and local employment.

14.3.15 Noise

Setting

Current sources of noise in the pending lease areas are limited to wind, dispersed recreational use, traffic from roads traversing the pending lease area, and wildlife. Sources of noise originating outside of the pending lease areas but affecting the pending lease areas include traffic from adjacent roads and air traffic.

Sensitive noise receptors are generally considered to be homes, hospitals, schools, and libraries. There are no sensitive receptors within the pending lease area. Sensitive receptors within half a mile of the pending lease area are limited to Wineglass Ranch, 0.4 miles south of the proposed lease site, and Darroughs Hot Springs, 0.5 miles east of the proposed lease site. Wildlife is also considered to be a sensitive noise receptor, depending on the species present in the project area. Wildlife in the project area is discussed in sections 3.10, *Fish and Wildlife*, and 3.11 *Threatened and Endangered Species and Special Status Species*.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on noise.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on noise; however, geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. No sensitive receptors have been identified within the pending lease areas. Adjacent and nearby sensitive receptors would be protected from noise impacts since any projects approved by the BLM would be required to adhere to the BLM regulations, requiring that noise from a major geothermal operation shall not exceed 65 A-weighted decibels at the proposed lease boundary. Impacts on wildlife from noise sources are discussed in Sections 3.10, Fish and Wildlife, and 3.11 Threatened and Endangered Species and Special Status Species.

Cumulative Impacts

The Proposed Action would not have any cumulative impact on noise; however, geothermal exploration and development activities likely to follow leasing, in combination with other nearby geothermal development, would potentially result in such impacts. Any cumulative construction or operation activity that causes noise disturbance would adhere to local, state, and federal regulations; therefore no cumulative noise impacts are expected.

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CHAPTER 15

MT. HOOD NATIONAL FOREST

PRINEVILLE FIELD OFFICE

ANALYSIS FOR PENDING LEASE APPLICATIONS:

OROR 017049, OROR 017051, OROR 017052, OROR 017053, OROR 017327

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SECTION 15.1 INTRODUCTION

15.1.1 INTRODUCTION

This lease-specific analysis describes the environmental effects of leasing approximately 9,170 acres of NFS land within the Hood River and Barlow Ranger Districts of the Mount Hood National Forest and the BLM Prineville Field Office to private industry for the development of geothermal resources.

The lease sites are within the Hood River and Barlow Ranger Districts of the Mt. Hood National Forest, the surface management agency for the lease sites. Subsurface mineral rights are managed by the BLM Prineville District. The BLM issues leases with the consent of the Forest Service (Regional Forester upon recommendation from the Mt. Hood National Forest Supervisor) for the lands under application on the Mount Hood NF.

This lease-specific analysis serves as an information resource to aid decision-makers in determining whether these lands are appropriate for leasing under FS and BLM management policies and existing environmental regulations.

15.1.2 LOCAL REGULATORY CONSIDERATIONS

The pending lease application sites are located within Hood River County, Oregon and are subject to state and local regulations, as described below.

State of Oregon Renewable Portfolio Standard Program

The Oregon Renewable Portfolio Standard Program is an Oregon law that requires the largest utilities in Oregon to provide 25 percent of their retail sales of electricity from clean, renewable sources of energy in 2025. Smaller utilities will have similar, but lesser, obligations. Geothermal energy is included in the definition of renewable resources under the program.

Mount Hood National Forest Land and Resources Management Plan (1990)

The Mount Hood National Forest Land and Resources Management Plan (Forest Plan) guides all natural resource management activities and establishes management standards and guidelines for the Mount Hood NF. It describes resource management practices, levels of resource production and management, and the availability and suitability of lands for resource management (US Forest Service 1990).

The Forest Plan:

- Establishes Forestwide multiple-use goals and objectives;
- Establishes Forestwide standards and guidelines for future activities;
- Establishes management area direction, including management area prescriptions and standards and guidelines applying to future management activities in that management area;
- Establishes the allowable sale quantity for timber and identifies land suitable for timber management;
- Establishes monitoring and evaluation requirements; and
- Establishes nonwilderness multiple-use allocations for the Olallie/Mount Jefferson roadless area that was reviewed under 36 CFR 219.17 and not recommended for wilderness designation.

The Forest Plan identifies the following resource management goals that apply to geothermal leasing:

- Provide safe, efficient access for the movement of people and materials involved in the use and management of the Forest. Provide for construction and maintenance of roads, at a level that will minimize environmental damage.
- Facilitate the exploration and development of energy and mineral resources on the Forest while maintaining compatibility with other resource values
- Provide for use and occupancy of the Forest by public and private interests when compatible with other resource objectives.
- Integrate the activities of implementing the Forest Plan with activities of local dependent communities to: 1) improve employment opportunities, 2) improve incomes and well being of the nation's rural people, and 3) strengthen the capacity of rural America to compete in the global economy.

The Forest Plan estimates that, within the Forest, there are 4,300 acres available with high potential for geothermal resources, and 123,300 acres with moderate potential for geothermal resources (US Forest Service 1990).

The Forest Plan identifies the following Forest-wide standards and guidelines that apply to geothermal activity:

- FW-386 – Impacts of management activities on mineral resources shall be assessed.
- FW-394, 395, 396 – Mineral and geothermal lease applications should be reviewed within 90 days. Special lease stipulations when necessary to protect surface resources and/or achieve Management Area direction shall be required. Special lease stipulations for surface resource protection shall be provided to the USDI-Bureau of Land Management.
- FW-397 – A "no surface occupancy" stipulation shall be applied to leases only when:
  - Surface occupancy would cause significant other resource disturbance that could not be mitigated by any other means.
  - The activity is incompatible with other resource values and management objectives.
- FW-405 – The Forest shall cooperate with the Bureau of Land Management in analyzing and processing surface use plans of operations for leasable minerals proposals.

Northwest Forest Plan (1994)

The Northwest Forest Plan (NWFP) is an overall vision for the Pacific Northwest that would produce timber products while protecting and managing impacted species. The Plan focuses on the following five key principles (US Forest Service 1994):

- Never forget human and economic dimensions of issues;
- Protect long-term health of forests, wildlife, and waterways;
- Focus on scientifically sound, ecologically credible, and legally responsible strategies and implementation;
- Produce a predictable and sustainable level of timber sales and non-timber resources; and
- Ensure that Federal agencies work together.

The mission of the NWFP is to adopt coordinated management direction for the lands administered by the FS and the BLM and to adopt complimentary approaches by other Federal agencies within the range of the northern spotted owl. The management of these public lands must meet dual needs: the need for forest habitat and the need for forest products. With the signing of the Northwest Forest Plan Record of Decision in 1994, a framework and system of

Standards and Guidelines were established, using a new ecosystem approach to address resource management (US Forest Service 1994).

The NWFP includes the following Standards and Guidelines that apply to geothermal development in Late-Successional Reserves:

> Mining - The impacts of ongoing and proposed mining actions will be assessed, and mineral activity permits will include appropriate stipulations (e.g., seasonal or other restrictions) related to all phases of mineral activity. The guiding principle will be to design mitigation measures that minimize detrimental effects to late-successional habitat.

The NWFP includes the following management measures that apply to geothermal development in Riparian Reserves:

MM-1. Require a reclamation plan, approved Plan of Operations, and reclamation bond for all minerals operations that include Riparian Reserves. Such plans and bonds must address the costs of removing facilities, equipment, and materials; recontouring disturbed areas to near pre-mining topography; isolating and neutralizing or removing toxic or potentially toxic materials; salvage and replacement of topsoil; and seedbed preparation and revegetation to meet Aquatic Conservation Strategy objectives.

MM-2. Locate structures, support facilities, and roads outside Riparian Reserves. Where no alternative to siting facilities in Riparian Reserves exists, locate them in a way compatible with Aquatic Conservation Strategy objectives. Road construction will be kept to the minimum necessary for the approved mineral activity. Such roads will be constructed and maintained to meet roads management standards and to minimize damage to resources in the Riparian Reserve. When a road is no longer required for mineral or land management activities, it will be closed, obliterated, and stabilized.

MM-4. For leasable minerals, prohibit surface occupancy within Riparian Reserves for oil, gas, and geothermal exploration and development activities where leases do not already exist. Where possible, adjust the operating plans of existing contracts to eliminate impacts that retard or prevent the attainment of Aquatic Conservation Strategy objectives.

MM-6. Include inspection and monitoring requirements in mineral plans, leases or permits. Evaluate the results of inspection and monitoring to effect the modification of mineral plans, leases and permits as needed to eliminate impacts that retard or prevent attainment of Aquatic Conservation Strategy objectives.

15.1.3 Scope of Analysis and Approach

This lease-specific analysis incorporates by reference the programmatic analysis presented in Volume I. This lease-specific analysis examines the cluster of five pending lease application sites, describes the Reasonably Foreseeable Development scenario for this cluster, examines the existing environmental setting, and describes the potential direct and indirect impacts that issuing leases, and the anticipated future actions following leasing, would have on the human and natural environment.

This report focuses on specific key resource concerns in the cluster, and incorporates by reference the impacts described in the PEIS. Decision-makers should consider both the impacts described in this lease-specific analysis, in addition to those described in the main body of the PEIS. The analysis presented here does not reiterate the details of impacts identified in the PEIS, but rather refers to them as they arise in the impact analysis for pending lease application sites addressed here. Mount Hood National Forest staff members were contacted during the preparation of this lease-specific analysis to help identify local resource concerns.

15.1.4 Cumulative Actions

Consultation with the Mount Hood National Forest did not identify any projects that would cumulatively contribute to impacts within the project area.

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SECTION 15.2
PROPOSED ACTION AND ALTERNATIVES

15.2.1 INTRODUCTION

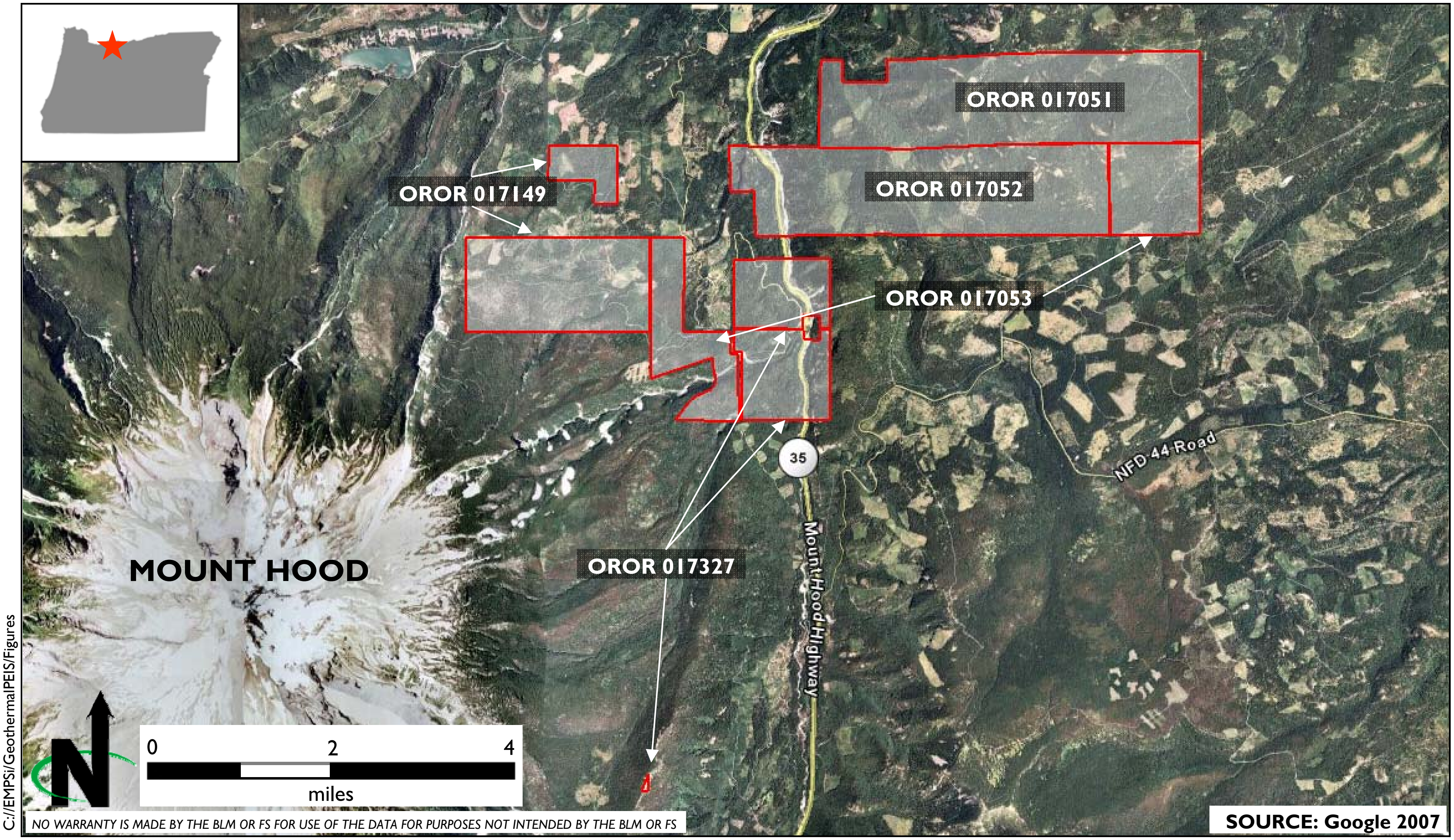
This chapter provides the details of the proposed action, alternatives to the proposed action, and an overview of the reasonably foreseeable develop (Reasonably Foreseeable Development) scenario for pending lease application sites OROR 017049, 017051, 017052, 017053, 017327.

15.2.2 PROPOSED ACTION

The proposed action is for the (1) Forest Service to provide a consent determination to the BLM to issue a lease for two areas within the Mount Hood National Forest and Prineville BLM District; and (2) BLM to issue said leases. The 9,169.98 acres of land are in the foothills to the east and northeast of Mount Hood, in Hood River County, Oregon (see Figure 15-1). Lease boundaries could be adjusted in the decision to avoid unacceptable impacts on sensitive resources.

The lease area comprises five lease sites:

- OROR 017049 – 1,538 acres consisting of two adjacent sections of land and an approximate third of nearby section. The legal description of this land is (1) T2S R9E S1; (2) T2S R9E S2; (3) T1S R9E S36, parts W2NE, N2NW, N2S2NW, NWSE.
- OROR 017051 – 2,480 acres consisting of three contiguous sections of land and an approximate seven-eighths of a fourth adjacent section. The legal description of this land is (1) T1S R10E S25; (2) T1S R10E S26; (3) T1S R10E S27; (4) T1S R10E S28, parts S2, S2N2, NENE, NWNW.
- OROR 017052 – 2,480 acres consisting of three contiguous sections of land and an approximate seven-eighths of a fourth adjacent section. The legal description of this land is (1) T1S R10E S32, parts N2, SE, E2SW; (2) T1S R10E S33; (3) T1S R10E S34; (4) T1S R10E S35.



All lease sites are on NFS lands. The East Fork of the Hood River runs alongside the Mount Hood Highway.

LEGEND:
Lease site boundary

Mount Hood Lease Locations
OROR 017149, 017051, 017052, 017053, 017327
Mt. Hood NF / Prineville District

Figure 15-1

- OROR 017053 – 1,376.77 acres consisting of one section and parts of two other sections that are contiguous with one another, but approximately 4.3 miles from the first section. The legal description of this land is (1) T1S R10E S36; (2) T2S R10E S6, "all excluding HES 149 & 151;" (3) T2S R10E S7, "M&B outside wilderness".
- OROR 017327 – 1,294.81 acres consisting of portions of two adjacent sections and a small parcel approximately 4 miles from the first two sections. The legal description of this land is (1) T2S R10E S5, parts "S2N2, S2 including part of HES 147 and HES 152, Lots 1-4;" (2) T2S R10E S8, "all including HES 153 and part of HES 152;" (3) T2S R9E S36, "SESE excluding wilderness."

The large grouping of lease sites range in elevation from 3,200 feet to 4,800 feet above mean sea level, with the isolated small parcel of land to the south situated atop a ridge at approximately 5,600 feet above mean sea level. The lease area is largely covered by forest, with substantial portions in various stages of regrowth from past timber harvest. Several creeks cross the lease area, most notably East Fork Hood River. The lease area is traversed by several forest roads and trails, and by the Mount Hood Highway, which runs alongside the East Fork Hood River.

There are no official recreation areas within the lease area. There are two adjacent recreation areas: The Cooper Spur Mountain Resort, which is immediately adjacent to the western edge of section 7 of lease OROR 017053, and a campground, which is adjacent to the southeastern edge of section 36 of the same lease.

There are numerous residences within one mile of lease sites OROR 017049 and 017053.

15.2.3 ALTERNATIVES

Two alternatives are considered in this lease-specific analysis: Alternative A, the No Action alternative, and Alternative B, Leasing with Stipulations.

Alternative A: No Action

Under Alternative A, the FS would not issue a consent determination for the four pending lease applications.

Alternative B: Leasing with Stipulations

Under Alternative B, the FS would provide a consent determination for the lease applications, and the BLM would issue the leases with the stipulations identified in Chapter 2 of the PEIS.

15.2.4 REASONABLY FORESEEABLE DEVELOPMENT SCENARIO

All of the lease sites are likely to be developed for electricity generation. The pending noncompetitive lease applications were filed by Portland Electric Corporation in 1976-77, now called Portland General Electric.

Portland General Electric expects to develop two power plants; one 30-megawatt plant to the west of Mount Hood Highway (Hwy 35) and the East Fork Hood River, and one 20-megawatt plant to the east of the highway and river.

The 30-megawatt plant to the west is most likely to be sited in the flat valley of sections 6 and 7 of OROR 017053 or Section 36 of OROR 017049.

The 20-megawatt plant to the east is most likely to be sited in the hilly area of sections 27 and 28 of OROR 017051. This location is within the area proposed to become the Shellrock Mountain National Recreation Area.

It is expected that a 30-megawatt plant would result in 15 acres of land disturbance, and a 20-megawatt plant would result in 10 acres of land disturbance, for a total disturbance of 25 acres. Existing Forest Service roads would be used to access the sites.

Portland General Electric acknowledges that while over 9,000 acres of land are included in the lease area, most of the land is not feasible to develop due to proposed wilderness areas, river riparian setbacks, steep slopes, cliffs, wilderness areas, ski areas, and protected watershed for The Dalles.

Exploration activities for a 20-megawatt plant and a 30-megawatt plant are expected to involve approximately 12 temperature gradient holes, disturbing approximately 0.15 acre each, for a total disturbance of approximately 2 acres. Disturbance would result from the types of activities described under Chapter 2 of the PEIS under *Phase One: Geothermal Resource Exploration*.

Assuming that a commercially viable resource is found within both portions of the lease area identified as being suitable, drilling operations and development of the site would be expected to result in a further approximately 8 acres of land disturbance (roughly 5 acres for the 30-megawatt plant and 3 acres for the 20-megawatt plant) from the types of activities described in the Reasonably Foreseeable Development scenario of Chapter 2 of the PEIS under *Phase Two: Drilling Operations*.

Utilization, the third phase of a geothermal project, is expected to result in a further approximately 15 acres of land disturbance (roughly 9 acres for the 30-megawatt plant, and 6 acres for the 20-megawatt plant) from the types of activities described in the Reasonably Foreseeable Development scenario of

Chapter 2 of the PEIS under *Phase Three: Utilization*. The length and alignment of transmission lines are not estimated here since these factors would depend upon the positioning of any power plant and the distance to the nearest electrical tie-in.

Reclamation and abandonment, the fourth phase of a geothermal project, is expected to result in temporary disturbance of all originally disturbed acres, after which, the site would graded and vegetated to pre-disturbance conditions, as described in the Reasonably Foreseeable Development scenario of Chapter 2 of the PEIS under *Phase Four: Reclamation and Abandonment*.

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SECTION 15.3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

15.3.1 INTRODUCTION AND GEOGRAPHIC SETTING

The following resource disciplines are not addressed in this section because they are not found in the leasing areas and are not relevant to the discussion: wild horse or burros, livestock grazing, and historic or scenic trails.

All the pending lease applications are in geologic units that would be expected to have a relatively low potential for containing vertebrate fossils or scientifically significant invertebrate or plant fossils; therefore, paleontological resources are not analyzed in detail. Paleontological mitigative procedures outline in the PEIS would be followed for all ground-distributing activities. Protective measures outlined in the PEIS would be applied.

Future development of the proposed lease sites would also yield the same health and safety impacts as identified in Chapter 4 of Volume I of the PEIS and therefore are not repeated in this lease-specific analysis.

15.3.2 LAND USE, RECREATION AND SPECIAL DESIGNATIONS

Setting

This section is a discussion of the current land ownership and use within the Region of Influence (ROI) for the five lease sites that are part of the proposed action. The ROI is the land area within and adjacent to the potential lease sites.

Policies and Plans

It is the policy of the Department of the Interior, consistent with Section 2 of the MMPA and Sections 102(a) (7), (8) and (12) of FLPMA, to encourage the development of mineral resources, including geothermal resources, on federal lands. The Geothermal Steam Act of 1970 provides regulatory guidance for geothermal leasing by the BLM. The Mount Hood National Forest LRMP as amended by the NWFP provides direction for land use in the lease area. Additional details of this plan are discussed in Section 15.3.1.

Regional Setting

The pending lease areas are within NFS lands to the east and northeast of Mount Hood, Oregon. Adjacent land is primarily within the NFS, with smaller parcels of private land and public land interspersed. The primary land uses in the area are forestry and recreation.

Special Designations

There are no existing wilderness areas, national recreation areas, or wild and scenic rivers within the lease sites. Existing lease boundaries have already been adjusted to avoid overlap with existing wilderness areas; specifically, the lease boundary of OROR 017053 in Section 7 has been revised to avoid the Mount Hood Wilderness.

A review of FS Geographical Information Systems data shows that the following areas are within an Inventoried Roadless Area:

- OROR 017327 – Southern one-third of Section 8, west of East Fork Hood River
- OROR 017049 – Northwest corner of Section 2

According to the Northwest Forest Plan:

- Portions of OROR 017051, 017052, and 017053 lease areas are in a designated Late-Successional Reserve and a Key Watershed;
- Portions of OROR 017049 and 017053 are in an Administratively Withdrawn Area; and
- Riparian Reserves form a buffer around all streams and rivers within the lease area. The width of these reserves is based on the presence or absence of fish and if the stream is perennial or intermittent. Riparian Reserves exist within all proposed lease areas.

Section 15.1 of this analysis discusses the standards and guidelines set forth in the NWFP related to geothermal development in Riparian Reserves. NWFP guidance on Late-Successional Reserves does not address geothermal development. NWFP guidance on Key Watersheds includes a description of an Aquatic Conservation Strategy. The applicable portions of this strategy are:

- Reduce existing system and nonsystem road mileage outside roadless areas. If funding is insufficient to implement reductions, there will be no net increase in the amount of roads in Key Watersheds.

- Key Watersheds are highest priority for watershed restoration.
- Watershed analysis is required prior to management activities, except minor activities such as those Categorically Excluded under NEPA (and not including timber harvest).
- Timber harvest cannot occur in Key Watersheds prior to completing a watershed analysis.

Additionally, portions of the lease areas are contained within management areas with special designations for wildlife protection under the Forest Plan. Details for these designations are provided in Section 15.3.9 *Fish and Wildlife*.

On July 25, 2007, the Senate Energy and Natural Resources Committee passed the Lewis and Clark Mount Hood Wilderness Act of 2007. This act requires approval of the Senate. There are several proposed wilderness areas, a national recreational area, and a wild and scenic river overlapping the lease sites. If these areas are given their proposed designations, these areas may be incompatible with mineral leasing.

All of the proposed lease sites would be affected by the proposed designations. Table 15.3-1 lists each of the proposed areas and the sites and sections that would be affected.

Table 15.3-1
Proposed Lewis and Clark Wilderness and Lease Sites Affected

Proposed Area	Lease and Section Affected
Tilly Jane Wilderness Area	OROR 017049 (Section 2)
Cloud Cap Wilderness Area	OROR 017049 (Sections 1, 2) OROR 017053 (Section 7)
Blue Grass Ridge Wilderness Area	OROR 017327 (Section 36)
East Fork Hood River Wild and Scenic River	OROR 017327 (Sections 5, 8) OROR 017052 (Section 32)
Shellrock Mountain National Recreation Area	OROR 017051 (Sections 27, 28)

Recreation

Existing recreational areas in or near the lease sites include the Copper Spur Mountain Resort, which is immediately adjacent to the western edge of Section 7 of lease OROR 017053, a campground, which is adjacent to the southeastern edge of Section 36 of the same lease, and a winter recreation area in portions of Section 4 of leases OROR 017049 and OROR 017053.

Lease Areas

OROR 017049

Cloud Cap road traverses sections 1 and section 2 from the SW to the SE. Road NFD 3511 winds through the northwest corner of the Section 2 portion of the lease site and the southeast corner of the Section 36 portion of the lease site. Other unnamed forest roads provide some additional access to section 1 and 36. Portions of the lease site have been clear cut. Evans Creek originates in Section 2 and leaves through the middle portion of the northern edge of that section. Crystal Springs Creek is slightly east of the point of origin of Evans Creek, and runs through the NE quarter section of Section 2, into the NW quarter section of Section 1. A small portion of the SW quarter of the SW quarter of Section 2 is within the Tilly Jane Proposed Wilderness Area. Approximately the southern half of Section 2 is within the Cloud Cap Proposed Wilderness Area, as are most of the SW quarter and about half of the SE quarter of Section 1.

OROR 017051

Alder creek traverses the northern portion of Section 25 and crosses through the NE and SE quarters of Section 26. Crow Creek passes through the NE and NW quarters of Section 26 as well as the eastern half of Section 27. Puppy Creek crosses from the SW corner to the NW corner of Section 28. Surveyors Ridge Road (NFD 17) crosses in a north-south alignment through the center of Section 27. No other developed land uses are found in this lease area. Approximately 50 percent of Section 27 and 50 percent of the Section 28 portion of the lease site are within the proposed Shellrock Mountain National Recreation Area.

Surveyors Ridge Trail #688 is within this lease area (Bambe 2008).

OROR 017052

Dog River Trail #675 and Bluegrass Ridge Trail #647 are within this lease area (Bambe 2008). Mount Hood Highway and the East Fork Hood River traverse the center of Section 32 in a north-south alignment. Dog River crosses from the SE quarter to the NW corner of Section 33. Unnamed forest roads provide some additional access to section 33 and 34. NFD 17 crosses Section 34 through the center in a north-south alignment. South Fork Mill Creek travels through the eastern portion of Section 34, and through the southern half of Section 35. Approximately 75 percent of the Section 32 portion of the lease site is within the proposed East Fork Hood River Wild and Scenic River area. A small portion of the NW quarter of Section 34 is within the proposed Shellrock Mountain National Recreation Area.

OROR 017053

Elk Meadows Trail #645 and Tamanawas Falls Trail #650A are within this lease area (Bambe 2008). The John Mill Trail and Brooks Meadow Road/NFD 1720 travel across the SE quarter of Section 36. The South Fork Mill Creek crosses through the southern half of Section 36. NFD 1721 loops into the NE and SE quarters of Section 36. Tilly Jane and Doe Creeks traverse Section 6, with Doe Creek also passing through the NW quarter of Section 1. Polallie Creek crosses through the NE quarter of Section 7, and Cold Spring Creek passes through the SE quarter of Section 7. The Section 6 portion of the lease site has an unnamed forest road in its SW quarter. The northern half of Section 7 contains two developed roads: Cloud Cap Road, and Copper Spur Road (NFD 3511). Approximately one-third of the Section 7 portion of the lease site is within the proposed Cloud Cap Wilderness Area.

OROR 017327

Four named trails exist in this lease site: East Fork Trail #650, the Tamanawas Falls Trail #650A, Elk Meadows Trail #645 (Bambe 2008) and the Zig Zag Trail. The south fork of Spring Creek transects the section into north and south in the western half of the section. The East Fork Hood River crosses through the eastern halves of sections 5 and 8 in a north-south alignment. Approximately 50 percent of these two sections lie within the proposed East Fork River wild and scenic river area. Polallie Creek traverses the NE quarter of Section 8. Buck Creek passes through Section 6. The Section 36 portion of this lease site lies within the proposed Blue Grass Ridge Wilderness Area.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on existing land uses, including existing recreational uses and would not conflict with the Mount Hood LRMP or the NWFP.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impacts on land use or recreation; however, the anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Portions of the lease areas lie within areas proposed to become Wilderness Areas, National Recreation Areas, and Wild and Scenic Rivers; however, at the time of writing of this analysis, these designations had not been approved. Should these designations be granted to these lands prior to the issuance of leases, the lease boundaries should be revised to exclude these special designations. If leases are issued prior to these designations being granted, the proposed action would be consistent with the Mount Hood LRMP and the NWFP.

Additional discussion of impacts on land use and dispersed recreation from geothermal plant development is provided in Section 4 of the PEIS, under *Land Use, Recreation and Special Designations*.

Anticipated actions following leasing have the potential to conflict with management guidelines and standards set forth by the Northwest Forest Plan and the Mount Hood Forest Plan for those areas contained within Late Successional Reserves, Riparian Reserves, Key Watersheds and within Inventoried Roadless Areas and management areas with special designations for wildlife protection under the Forest Plan.

Impacts on Riparian Reserves

Per the discussion of the Northwest Forest Plan in Chapter 1, no new geothermal development is permitted in Riparian Reserves where leases do not already exist. On federal lands, riparian reserves are designated to protect water quality; timber harvest is prohibited and ground disturbances are not allowed. The reserve's width is based on the presence of fish and whether the stream is permanent or intermittent (see Table 15.3-2 below). Riparian reserve widths are determined by the average maximum height of the tallest trees in the area, "site-potential tree height," or a minimum width requirement. Any development within the Riparian Reserve would have the potential to conflict with the Northwest Forest Plan and the Mount Hood Forest Plan. The issuance of pending noncompetitive lease applications would not conflict with the NWFP with respect to Riparian Reserves if lease stipulations state that no surface-disturbing activities are to occur within the designated riparian buffer zones based on the above criteria.

Table 15.3-2
Federal Riparian Reserve Width Requirements (Each Side of the Stream)

Stream Class	Riparian Reserve Width
Fish Bearing	Average height of 2 site potential trees or 300 feet
Permanent Non-Fish Bearing	Average height of 1 site potential tree or 150 feet
Intermittent	Average height of 1 site potential tree or 100 feet

Impacts on Key Watersheds

No new roads are permitted within the project area. The issuance of pending noncompetitive lease applications OROR 017051, 017052, and 017053 would not conflict with the NWFP with respect to Key Watersheds if lease stipulations state that no new roads shall be constructed.

Impacts on Late-Successional Reserves

Anticipated actions following lease issuance have the potential to impact old growth forests in Late-Successional Reserves. The Standards and Guidelines in the NWFP for Late-Successional Reserves require that the Mount Hood NF assess the impacts of proposed mining actions, and that the NF include in mineral activity permits appropriate stipulations (e.g., seasonal or other restrictions) related to all phases of mineral activity. The guiding principle is to design mitigation measures that minimize detrimental effects to late-successional habitat. These mitigation measures would reduce impacts on Late-Successional Reserves.

Potential conflicts with other wildlife management areas are discussed further in Section 15.3.9 *Fish and Wildlife*.

Impacts on Inventoried Roadless Areas

Portions of lease sites OROR 017049 and 017327 are within an Inventoried Roadless Area. Development in these areas would be consistent with this designation as long as no new roads were constructed to access the sites.

15.3.3 Geologic Resources and Seismicity

Setting

The pending lease sites lie within the Pacific Mountain System portion of the Pacific geological province, which extends from southern California through the Kenai Fjords of Alaska. The Pacific province is one of the most geologically young and tectonically active regions in North America. The region straddles the boundaries between several tectonic plates, including the Juan de Fuca and North American plates. Where the Juan de Fuca Plate converges with the North American Plate the Cascade subduction zone occurs as the heavier oceanic plates slide underneath the buoyant North American plate (US Geological Survey 2004).

There are some unusual features at the Cascade subduction zone. Where the Juan de Fuca plate sinks beneath the more buoyant North American Plate there is no deep trench, lower seismic activity than expected, and there is evidence of a decline in volcanic activity over the past few million years. The probable explanation lies in a present slower rate of convergence (three to four centimeters per year) (US Geological Survey 2004).

As subduction occurs, high temperatures and pressures allow water molecules locked in minerals of solid rock to escape. The water vapor rises into the pliable mantle above the subducting plate, causing some of the mantle to melt. This newly formed magma rises toward the Earth's surface to erupt, forming a chain of volcanoes, known as the Cascade Range, above the subduction zone. The Cascade Range extends from British Columbia to Northern California, roughly parallel to the coastline. Within this region 13 major volcanic centers line in sequence. Initially formed 36 million years ago, the range's major peaks date to the Pleistocene. The majority of the Cascades consist of small, short-lived volcanoes built on a platform of lava and volcanic debris. Rising above this platform, a few large volcanoes, including Mt Hood, dominate the landscape (US Geological Survey 2004).

All the lease sites lie within approximately 12 miles of the summit of Mount Hood. Mount Hood is a major active volcano of the Cascade Range; its most recent series of eruptions occurred about 1,500 years ago and in the 1790s, just prior to the Lewis and Clark expedition. A 1997 report by the US Geological

Survey that analyzes potential hazardous geological events at Mount Hood indicates the presence of vents on the east, north and west flanks, as well as on the summit, and labels the area that contains the lease sites as a hazard zone. Areas along the East Fork Hood River, just north of the lease sites, are subject to Lahars (large mudflows of pyroclastic material and water that flow down from volcanoes) generated by eruptions at vents located on the upper east or north flanks of the mountain. The region is also susceptible to debris avalanches and related lahars of about 50 million cubic meters. US Geological Survey places the 30-year probability of a lahar occurring in this area at 1 in 300 (US Geological Survey 1997).

Landslides are the most significant geologic hazard in the lease area. The steep slope areas on all the leases are susceptible to landslides. Many of the steep gradient creeks are susceptible to debris flows.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on geological resources and would not put any people or structures at risk from seismic-related events.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impacts on geological resources or put people or structures at risk from seismic events; however, anticipated actions following leasing could have impacts on these resources and result in risks related to seismicity through development of geothermal resources, which would include increased human presence in the lease area, and construction of facilities, infrastructure and transmission lines. Also, seismic- and non-seismic-related landslides could damage infrastructure and cause injury to humans.

Any development should avoid unstable or potentially unstable areas.

Prior to construction of any facilities or infrastructure, geotechnical investigations would need to be conducted to ensure that any construction can withstand strong seismic events, and that facilities would be placed within safe distances from potential lahar and debris-slide areas.

15.3.4 Energy and Minerals

Setting

The utility provider for Hood River County is Hood River Electric Cooperative. The Cooperative purchases power from Bonneville Power Administration. Bonneville Power Administration serves the Pacific Northwest through an extensive electricity transmission system and has an average annual generation of approximately 8,848 MW. Bonneville Power Administration markets wholesale electric power from 31 federal hydro projects (supplying about 80 percent of Bonneville Power Administration's power), one non-federal nuclear plant, and several power plants. Bonneville Power Administration is working toward compliance with state Renewable Energy Standards by marketing wholesale electrical power at cost from federal dams and other nonfederal hydroelectric and wind energy generation facilities (Bonneville Power Administration 2007).

No locatable minerals have been identified in the proposed lease area. In the Mount Hood NF, three mining districts have been identified: the Oak Grove District, the Laurel Hill District, and the North Santiam District (US Forest Service 1990).

There has been significant interest in geothermal resource potential in the region. A total of 26,860 acres have been identified as having high resource potential, although almost 9,000 of these are in a Wilderness Area and therefore withdrawn from mineral leasing. Three geothermal resource potential areas had been identified in the Forest: the summit of Mount Hood, Carey Hot Springs adjacent to the Clackamas River, and Breitenbush in the Southern Portion of the Clackamas District. The three resource potential areas cover a total of 17,920 acres. As of 1990, 127 non-competitive lease applications were filed in areas both within and outside the resource potential areas (US Forest Service 1990). Within the BLM district, additional geothermal resources are being developed. The BLM has recently conducted an environmental analysis on the Newberry Geothermal Area in Deschutes County, with a finding of no significant impact (Bureau of Land Management 2007).

No other leasable minerals have been identified in the lease area (US Forest Service 1990). The 1982 Geothermal Resources of Oregon map noted test wells on the west, south, and northwest sides of Mt. Hood, but none on the east or northeast sides.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on energy and mineral resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on energy or mineral resources; however, anticipated future actions following leasing would potentially result in the development of geothermal resources at the pending lease sites. One 20-megawatt and one 30-megawatt plant are proposed for development in the lease area for a total of 50 megawatts. Details of impacts on energy and minerals are discussed for a standard 50 MW plant in Section 4 of the PEIS, *Energy and Minerals*. Similar impacts are anticipated at the lease site.

This impact would allow existing geothermal resources in the area to be utilized and would contribute a renewable source of energy to the regional power grid.

15.3.5 Soils

Setting

OROR 017149

Limited soil data are available for OROR 017049. Given the proximity to other lease sites, Sections 1 and 2 would likely be dominated by soil types seen at nearby lease sites OROR 017053 and OROR 017327. No prime or unique farmlands exist at this site (Natural Resource Conservation Service 2008).

OROR 017051

Soils at OROR 017051 are dominated by Bins-Bindle association, a mixture of soils formed by volcanic ash and loess overlaying colluvium derived from basalt and andesite. Slopes of these soil types are generally 20 to 70 percent, with a depth of 20 to 60 inches to lithic bedrock. The soils are moderately well drained, with no frequency of flooding, and have a low to moderate available water capacity. Gravelly and stony loam formed from volcanic rock, are found at the NW corner of the lease site, with gravelly loam concentrated a slopes ranging from 45 to 75 percent and stony loams concentrated at 8 to 65 percent. No prime or unique farmlands exist at this site (Natural Resource Conservation Service 2008).

OROR 017052

Limited soil data are available for the portions of the lease areas to the east of Section 32. Soil type is likely similar to that of OROR 017051, with gravelly and sandy loam concentrated in the western area of Section 32 and Bins-Bindle association soil dominating the remaining site area. Farmland of statewide importance exists along the southwest edge of Section 32 but does not fall within the lease area (Natural Resource Conservation Service 2008).

OROR 017053

Limited soil data are available for Section 7 and 36. Soil types in Section 36 are expected to be similar to those at OROR 017051, given the proximity of the two areas. Soils in Section 6 and likely in Section 7 are dominated by Hudson fine sandy loam, a derivative of volcanic ash and colluvium. Slopes of this soil type range from 0 to 30 percent, with a depth of more than 80 inches. The soil is well drained, with no frequency of flooding, and high water capacity. No prime or unique farmland exists at this site (Natural Resource Conservation Service 2008).

OROR 017327

Limited soil data are available for the portions of the lease areas in Sections 8 and 36. Soil data are not available for Section 36. Soil in Section 5 and likely in

Section 8 is dominated by Hudson fine sandy loam, described under OROR 017053. Farmlands of statewide importance exist in the SWNW, NWNE, and NENE areas of Section 6 (Natural Resource Conservation Service 2008).

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on soils.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on soils; however, anticipated ground disturbance from the geothermal exploration and development activities likely to follow leasing would potentially result in impacts on erosion and soil productivity. Prior to construction of any facilities or infrastructure, geotechnical investigations would need to be conducted to ensure that any construction be situated on stable soils and that erosion-prevention measures be implemented in accordance with permitting requirements.

15.3.6 Water Resources

Setting

Surface Water

The lease areas are within the Hood Basin, which drains the northern and eastern slopes of Mount Hood. The lease sites to the west of the East Fork Hood River are within the Western Hood Subbasin, and the lease sites to the east of the East Fork Hood River are within the Middle Columbia-Hood Subbasin (Oregon Department of Environmental Quality 2008a). All sites are within the Middle Columbia-Hood Watershed (US Geological Survey 2008). A Total Maximum Daily Load (TMDL) for the Western Hood Subbasin was approved by the US Environmental Protection Agency on January 30, 2002. A TMDL for the Middle Columbia-Hood Subbasin is in progress as of April 2008 (Oregon Department of Environmental Quality 2008a).

East Fork Hood River runs through the center of the lease area, flowing to the north.

The following surface water features occur within the Western Hood Subbasin portion of the lease sites:

- Evans Creek
- Cold Spring Creek
- Crystal Spring Creek
- Tilly Jane Creek
- Doe Creek

- Polallie Creek
- Buck Creek

The following surface water features occur within the Middle Columbia-Hood Subbasin portion of the lease sites:

- Dog River
- Alder Creek
- Crow Creek
- Puppy Creek
- South Fork Mill Creek

Lands are used primarily for logging and irrigated and non-irrigated agriculture. The Oregon Department of Environmental Quality Laboratory monitored East Fork Hood River in the City of Hood River initially at the Highway 30 Bridge and presently at the footbridge north of Interstate 84, where the East Fork Hood River meets the Columbia River (Oregon Department of Environmental Quality 2008b). This monitoring location is approximately 18 miles downstream of the lease area. Water quality from this monitoring location is expected to be worse than water quality at the portion of the East Fork Hood River crossing through the lease area because substantial urban and agricultural runoff occurs in between the two locations; however, water quality concerns for the river as a whole can indicate which water quality parameters are of greatest concern for the East Fork Hood River, which can guide the impact analysis and management strategies for upstream areas.

Water quality at the terminus of the East Fork Hood River is occasionally impacted by high levels of total phosphates, biochemical oxygen demand, and fecal coliform during heavy precipitation and high flows. This indicates the introduction of inorganic and organic materials to the water by erosion and runoff from fields, ditches, and storm drains. Moderately high temperatures, and high levels of total phosphates, biochemical oxygen demand, and total solids during summer low flow periods have been noted. These concentrations increase as less water is available for dilution. On the average, Oregon Water Quality Index scores for East Fork Hood River are good in the summer and fair during the fall, winter, and spring (Oregon Department of Environmental Quality 2008b).

Section 303(d) of the Federal Clean Water Act requires that a list be developed of all impaired or threatened waters within each state. Table 15.3-3 shows the waterways within the lease sites, their beneficial uses, and the contaminants for which they are in 303(d)-impaired status.

Table 15.3-3
Beneficial Uses and Impairments of Waterways Within Lease Sites

Waterway	Beneficial Uses	303(d) listed	Contaminants
Alder Creek	None defined	No	No data available
Buck Creek	None defined	No	No data available
Cold Spring Creek	None defined	No	No data available
Crow Creek	None defined	No	No data available
Crystal Spring Creek	None defined	No	No data available
Doe Creek	None defined	No	No data available
Dog River	Human health, Aquatic life	Yes	Beryllium, iron
Evans Creek	Human health, Aquatic life, Resident fish and aquatic life, Water contact recreation, Cold water aquatic life, Salmonid fish rearing and spawning, Anadramous fish passage, Drinking water	Yes	Beryllium, copper, iron
East Fork Hood River	Human health, Aquatic life, Resident fish and aquatic life, Water contact recreation, Cold water aquatic life, Salmonid fish rearing, Anadramous fish passage, Salmon and steelhead spawning, Aesthetics, Fishing, Livestock watering	Yes	Beryllium, copper, iron
Polallie Creek	Resident fish and aquatic life, Salmonid fish rearing and spawning	No	None
Puppy Creek	None defined	No	No data available
South Fork Mill Creek	None defined	No	No data available
Tilly Jane Creek	None defined	No	No data available

Source: Oregon Department of Environmental Quality 2008c.

Ground Water

The lease sites lie within the Columbia Plateau regional aquifer system, an extensive set of aquifers and confining units that may locally be discontinuous but function hydrologically as a single aquifer system on a regional scale.

This regional aquifer occupies approximately 50,600 square miles in Idaho, Oregon, and Washington. The section of the aquifer in and around the lease sites is in undifferentiated volcanic and sedimentary rocks from the Pliocene era and younger, including beds of volcanic ash and tuff, silicic volcanic rocks, and semiconsolidated to consolidated sedimentary rock that contain small to large quantities of volcanic material. These rocks are complexly interbedded, and their permeability is extremely variable. The permeability of the various rocks that compose the aquifers is also extremely variable. Interflow zones and faults in basaltic lava flows; fractures in tuffaceous, welded silicic volcanic rocks; and interstices in coarse ash, sand, and gravel mostly yield less than 100 gallons per minute of water to wells. Interbedded almost impermeable rocks may retard the downward movement of groundwater and create perched water table conditions in some areas; however, Grande Ronde Basalt, a thick and extremely permeable volcanic rock, underlies the lease sites. Wells in the area discharge less that 10 to 500 gallons per minute. Discharge from the aquifer occurs via evapotranspiration, leakage to adjacent aquifers, withdrawals from wells, movement of water to surface-water bodies, and discharge from springs. Groundwater levels are highest in the spring as a result of recharge from snowmelt and decline through summer when the evapotranspiration rate causes discharge to exceed recharge. General movement of water in the area of the aquifer system overlain by the lease sites is from recharge areas near the edges of the basalt towards the Columbia River (US Geological Survey 1994).

Ground water quality is generally fresh and chemically suitable for most uses; sparse settlement in the area has prevented much groundwater contamination. Main groundwater uses in the region are for public, domestic and commercial, and agricultural purposes. Groundwater levels have been changed by irrigation practices, causing locally increased recharge and a rise in groundwater levels in some areas and declines (of as much as 300 feet) in others (US Geological Survey 1994).

Crystal Springs Zone of Contribution

Lease sites OROR 017053 (nearly all of Section 6 portion and the northwest corner of the Section 7 portion) and OROR 017049 (all except northwest half of Section 2 and western half of northwest quarter of Section 36) are within the Crystal Springs Zone of Contribution. The only reported pollutant at Crystal Springs is nitrate. Crystal Springs provides water for the Crystal Springs Water District, which serves a population of 5,000 people in the community of Odell, Oregon (Environmental Working Group 2008).

The Zone of Contribution coincides with the proposed Crystal Springs Management Unit, which is proposed for withdrawal from "*disposition under all laws pertaining to mineral and geothermal leasing or mineral materials*" in the current version of draft legislation (Bambe 2008).

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on water resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on water resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts, as described below. Lease stipulations addressing water resources are included in Appendix B of the PEIS and would reduce impacts on surface water quality, as would BMPs in Appendix D and measures required by the permitting process for any site-specific projects.

Surface Water Quality

Typical impacts on water quality from geothermal development are described in Chapter 4 of the PEIS under *Water Resources*. The East Fork Hood River, Dog River and Evans Creek are impaired water bodies due to the presence of beryllium, copper, and iron. Geothermal development does not typically produce these contaminants; however, if these elements are naturally occurring in local soils at high levels, ground-disturbing activities could result in stormwater runoff, carrying these contaminants to the impaired water bodies. Impacts on

Ground Water Quality

Development of the lease sites could result in the groundwater impacts discussed in Chapter 4 of Volume I of the PEIS. All construction and operation activities are expected to be conducted in compliance with state and local regulations and impacts on ground water quality are expected to be little to none.

The potential for groundwater impacts is of particular concern in lease sites OROR 017049 and 017053 due to their location in the Crystal Springs Zone of Contribution. Geothermal waters could introduce contaminants into the drinking water aquifer. Subsequent project-specific environmental reviews and permits would ensure that drilling procedures, including the installation of well casings and sealings, are conducted to current Oregon well construction standards.

If the Zone of Contribution area is removed from all existing lease applications through designation of the Crystal Springs Management Area, anticipated future actions following leasing would have no impacts on water quality at Crystal Springs.

Water Quantity

Indirect use geothermal projects require large amounts of water during all phases of a project from exploration through reclamation and abandonment;

therefore, anticipated future actions following leasing could result in indirect impacts on the surface water and ground water quantities. Specific geothermal development projects that may occur consistent with the Proposed Action would have a variety of water-sourcing options, including surface water, groundwater, and purchased water.

Project-specific environmental review would include consultation with the Crystal Springs Water District (for any proposed projects within the Crystal Springs Zone of Contribution), environmental groups, and other stakeholders. Additionally, drilling for groundwater would not occur without a ground water permit from the Oregon Water Resources Department, which would ensure sufficiency of the local aquifer to provide for both any approved project and competing users such as the Crystal Springs Water District. The Oregon Water Resources Commission is responsible for managing ground water to prevent depletion of the resource.

If the Zone of Contribution area is removed from all existing lease applications through designation of the Crystal Springs Management Area, anticipated future actions following leasing would have no impacts on water quantity at Crystal Springs.

15.3.7 AIR QUALITY AND ATMOSPHERIC VALUES

Setting

The lease area is located in Hood River County, an area with air quality status of Unclassified. Due to the remote location of the lease sites, air quality is considered to be good.

The Mount Hood Wilderness Area, adjacent to some of the lease sites, is within a Class I Airshed (Bambe 2008).

The lease site is in the Cascade Mountain Range which is about 75 miles east of the Coast Range. The climate is humid and cool. Air masses from the west rise at the range causing precipitation, though much less than at the Coast Range. The closest weather monitoring station to the lease site is at Parkdale, Oregon approximately five miles north of the lease area. Average maximum temperatures at Parkdale range from 39.0 degrees Fahrenheit in December to 80.9 degrees Fahrenheit in August, with average minimum temperatures ranging from 26.5 degrees Fahrenheit in December to 48.2 degrees Fahrenheit in July. Average annual precipitation at the Parkdale station is 33.2 inches (Western Regional Climate Center 2007).

Impacts

Alternative A (No Action)
The No Action alternative would have no impact on air quality or atmospheric values.

Alternative B (Proposed Action)
Neither the Proposed Action nor anticipated future actions following leasing would result in violations of ambient air quality standards given the Unclassified status of the county and the good level of air quality. Anticipated future actions following leasing would have impacts as described in Section 4.8 of this PEIS.

15.3.8 VEGETATION

Setting

The pending lease area is located within the western hemlock (*Tsuga heterophylla*) zone of the Northern Cascades Physiographic Province (Franklin and Dyrness 1988). Mt. Hood (elevation 11,245 feet above mean sea level) rises up from the lease area on the west. Events of both natural and human origin have modified forest stands in the lease area. Natural disturbance events include wind and snow storms, wildfire, and floods. Human disturbance of vegetation has occurred through timber management activities, fire, and recreational use. The lease area is a mosaic of forest stand ages, containing both old growth and second growth coniferous forest. The area is federally managed as NFS lands.

Late-Successional Reserves
In 1994 the NWFP designated a network of Late-Successional Reserves with the objective of protecting and enhancing conditions of late-successional and old growth forest ecosystems and the species that depend on this habitat (US Forest Service and Bureau of Land Management 1994). Timber harvest and other development activities are limited in Late-Successional Reserves. Several small areas designated as Late-Successional Reserves are found throughout the areas proposed for leasing (US Forest Service 2008b).

Old growth coniferous forests are characterized by very old and large overstory trees. Old growth forests have multiple structural attributes that make them high-value areas for wildlife, including variations in tree size and spacing, broken and deformed tops, multiple canopy layers, canopy openings, variation and patchiness of understory composition, and large-diameter standing dead and downed trees. This complex habitat supports a large number of plant and animal species, some of which are found only in late seral forests. Mature forests typically exhibit some, but not all, of the components of old growth forests. These forests make up much of the areas proposed for leasing.

Deciduous Forest and Shrub Habitats

Deciduous forest stands in the vicinity are found in sites with relatively recent ground disturbance, such as timber harvest and riparian zones along the East Fork Hood River and its tributaries. Red alder (*Alnus rubra*) is the dominant species in areas of disturbed soils within the western hemlock zone; it is also common within riparian zones. Big-leaf maple (*Acer macrophyllum*) is common in riparian zones and in openings in coniferous forest. Deciduous shrub communities may persist along the riparian corridors; these are typically dominated by willows (*Salix species*) and vine maple (*Acer circinatum*) (Franklin and Dyrness 1988). Deciduous forest stands along riparian zones can provide locally unique wildlife habitat when certain structural features are present. Such features can include variation and patchiness of understory vegetation, snags and downed logs, seasonal canopy cover, and stream shading.

Riparian Habitats and Wetlands

Riparian habitats are located at the interface between terrestrial habitats and aquatic environments. Deciduous forest and shrub habitats are characteristic along active channels of low-gradient waterways with well-developed floodplains. Riparian zones narrow with increasing stream gradient at the higher elevations within the proposed lease areas, leading to stands of mixed coniferous and deciduous species. Along narrow, higher-gradient streams, as are common in the lease area, coniferous tree species dominate the overstory.

Wetlands in the vicinity of the lease area include small areas of forested scrub and emergent wetlands (US Fish and Wildlife Service 2008a) along the floodplain of the East Fork Hood River. The most common tree species associated with forested wetlands are red alder, black cottonwood, and western redcedar. Freshwater forested scrub wetlands support a variety of sedges, forbs, and grasses (US Fish and Wildlife Service 2008a). Wetlands provide valuable plant, fish, and wildlife habitat and are also valued for their hydrologic functions. The US Forest Service manages the land adjacent to streams, lakes, reservoirs, and wetlands as Riparian Reserves, per the direction of the NWFP (US Forest Service and Bureau of Land Management 1994).

Riparian Reserves

On Federal lands, riparian reserves are designated to protect water quality; timber harvest is prohibited and ground disturbance is not allowed. The width of a riparian reserve is based on the presence of fish and whether the stream is permanent or intermittent. Riparian reserve widths are determined by the average maximum height of the tallest trees in the area or a minimum width requirement. Riparian reserves are found throughout the lease area, bordering all of the East Fork Hood River and its tributaries, as well as headwater streams of The Dalles watershed that is within the eastern portion of OROR 017053 (US Forest Service 2008b).

Invasive and Non-Native Plant Species

Invasive and non-native plant species (often called noxious weeds) are known to occur in the lease area and vicinity. The Oregon State Weed Board defines them as "*exotic, non-indigenous, species that are injurious to public health, agriculture, recreation, wildlife or any public or private property*" (Oregon Department of Agriculture 1999). The Oregon weed policy and classification system has been developed by the state of Oregon to provide a way to prioritize control programs for these species and to restrict their spread and effect on the environment. Treatment protocol of noxious weeds within the lease areas is outlined in the Forest-wide (Mt. Hood) Site-Specific Invasive Plant Treatment Environmental Impact Statement (US Forest Service 2008a). Table 15.3-4 shows invasive plant species expected to occur within the lease areas.

Table 15.3-4
Invasive Plant Species Expected in the Lease Area

Common Name	Scientific Name
Diffuse knapweed	*Centaurea diffusa*
Spotted knapweed	*Centaurea maculosa*
Canada thistle	*Cirsium arvense*
St. Johns-wort	*Hypericum perforatum*
Meadow knapweed	*Centaurea pratensis*
Tansy ragwort	*Sencio jacobaea*
Butter and eggs	*Linaria vulgaris*

SOURCE: US Forest Service 2005, 2008f

Impacts

Potential impacts on vegetation and important habitats could occur if reasonably foreseeable future actions were to:

- Affect a plant species, habitat, or natural community recognized for ecological, scientific, recreational, or commercial importance;
- Affect a species, habitat, or natural community that is specifically recognized as biologically significant in local, state, or federal policies, statutes, or regulations;
- Establish or increase noxious weed populations;
- Destroy or extensively alter habitats or vegetation communities in such a way that would render them unfavorable to native species; or
- Conflict with FS management strategies.

Alternative A (No Action)

The No Action alternative would have no impact on vegetation and important habitats.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on vegetation or important habitats or communities; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in impacts associated with the elimination and degradation of approximately 25 acres of habitat. Potential impacts associated with future exploration, drilling operations and development, utilization, and reclamation and abandonment would include:

- Habitat disturbance – Site clearing, well drilling, construction of access roads and geothermal facilities, and maintenance and operational activities would disturb timber and scrub habitat, increase risk of invasive species, and alter water and seed dispersion and wildlife use, which can further affect vegetation communities.
- Direct Removal and Injury – Trees and other vegetation would be cleared for roadways, vehicle staging, buildings, pipelines, and transmission lines. Activities could result in loss of soil, loss of seed bank in soil and deposition of dust. Maintenance around project components, such as drill pads, buildings, pipelines, or other facilities would involve mowing, herbicide treatment, and other mechanical or chemical means of removal and control. This would result in a net loss of important habitats and communities in the lease area.
- Invasive Vegetation – Disturbance and access by vehicles and human foot traffic may expose areas to colonization by invasive and non-native species, making it more difficult for endemic species to reestablish in disturbed areas and threatening the continued existence of endemic species (Bureau of Land Management 2007).
- Fire – Increased vehicular and human traffic, operation of equipment, the use of drilling muds, and the extraction of geothermal fluids can increase the risk of fires. Vehicles, electrical lines, and cigarette smoking can all result in accidental fires. Fires destroy valuable timber and forest vegetation and can aid in the establishment of invasive species.
- Erosion – Site clearing, grading, construction of access roads, containment basins, site runoff and vehicle and human foot traffic cause erosion. The effects of erosion include the removal of top soil, loss of seed bank, loss of native vegetation, the establishment of invasive species, the sedimentation of streams, and flooding (which can directly result in effects on riparian vegetation and riparian habitats).
- Exposure to Contaminants – Vehicle fuel, hydraulic fluid, solvents, cleaners, and geothermal fluids can all be harmful to vegetation and important habitats such as riparian areas. Accidental spills can

contaminate soils and water and directly harm vegetation. Licensed herbicide use would likely be used to control vegetation around geothermal facilities and support structures. Spills of herbicides or acute exposure to herbicides can have adverse effects on non-target vegetation.

Old Growth and Late Successional Reserves

Old growth, including Late-Successional Reserves, are scattered throughout the areas proposed for leasing. These forests are protected under the provisions of the NWFP (US Forest Service 1994); these protections are expected to remain in place in the future. Geothermal development of the lease areas would result in the removal of forest, and may include old growth and Late-Successional Reserves. Specific impacts affecting old growth forest are discussed further in Volume I of the PEIS, in Section 4.9, *Vegetation and Important Habitats*.

Riparian and Wetland Habitats

Riparian habitats are found along the East Fork Hood River and its tributaries, as well as headwater streams in The Dalles watershed. These habitats are protected as part of the NWFP and would be protected through best management practices if the lease sites are developed. Development is not allowed within riparian reserves; however, potential impacts on riparian habitats would still exist. They would include sedimentation, runoff, erosion, and effects to water quality and hydrology. Refer to Section 4.9 in Volume I of the PEIS for a more detailed discussion of the potential impacts on riparian habitats resulting from each stage of a geothermal project.

Impacts that could occur on wetlands include dewatering, changes in hydrology, disturbance, and removal. Impacts on wetlands are regulated under the River and Harbors Act and Section 404 of the Clean Water Act. Permitting from the US Army Corps of Engineers (Corp) will be required if future development at the site will have any impact on wetlands under Corps' jurisdiction. In addition, EO 11990, "Protection of Wetlands," requires all federal agencies to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. Wetland habitats exist along the East Fork Hood River, which traverses north-south through much of the area proposed for leasing (US Forest Service 2008a). Other wetlands may exist within the lease area but have not been recorded; however, conditions are dynamic and may change over time. Wetland delineations would be conducted prior to activities that may disturb wetlands as the result of geothermal activities at the pending lease sites. A more complete discussion of the potential impacts on wetlands resulting from geothermal activities can be found in Section 4.9 in Volume I of the PEIS.

15.3.9 FISH AND WILDLIFE

Setting

Fisheries

The following section describes the existing aquatic habitat and fish species occurring in East Fork Hood River and its tributaries, as well as fish that may occur in the headwater streams of The Dalles watershed. The waterways provide habitat for rainbow trout (*O. mykiss*), cutthroat trout (*O. clarki*), long-nosed (*Rhinichthys cataractae*) and black sided dace (*Phoxinus cumberlandensis*), and sculpins (US Forest Service 2008). Steelhead trout (*O. Mykiss*) are also present or expected to occur in both the East Fork Hood River and its tributaries, and waters of The Dalles watershed (US Forest Service 2008).

Wildlife

Reptiles and Amphibians

Reptiles likely to inhabit the area include the western terrestrial garter snake (*Thamnophis elegans*), common garter snake (*Thamnophis sirtalis*), and northern alligator lizard (*Elgaria coerulea*). Amphibians potentially present in the riparian habitat occurring in the lease sites include Pacific giant salamander (*Dicamptodon tenebrosus*), northwestern salamander (*Ambystoma gracile*), long-toed salamander (*Ambystoma macrodactylum*), northern rough-skinned newt (*Taricha granulosa*), Pacific chorus frog (*Pseudacris regilla*), northern red-legged frog, and the non-native bullfrog (*Rana catesbeiana*) (US Forest Service 2005). Larch mountain salamander *(Plethodon larselli*) may be found in higher elevations where there are talus slopes. There is also potential for Oregon slender salamander (*Batrachoseps wrightii*) in the lower elevations of lease areas (Dyck 2008).

Birds

Forested habitats in the lease area may contain game birds, raptors, songbirds, and other birds. Bird species closely associated with old growth and late successional forests found in the lease area include the northern spotted owl (*Strix occidentalis* spp. *caurina*), a federally listed species (see Section 3.11 below for further discussion). Species closely associated with deciduous forest and shrub habitats in the lease area include willow flycatcher (*Empidonax trailii*), yellow warbler (*Dendroica petechia*), MacGillivray's warbler (*Oporornis tolmiei*), black-capped chickadee (*Parus atricapillus*), red-eyed vireo (*Vireo olivaceous*), olive-sided flycatcher (*Contopus cooperi*), and ruffed grouse (*Bonasa umbellatus*).

Mammals

Large mammals in the lease area and surrounding vicinity include blacktailed deer (*Odocoileus hemionus columbianus*), elk (*Cervus elaphus*), black bear (*Euarctos americanus*), and mountain lion (*Felis concolor*). Furbearer species in the lease area include river otter (*Enhydra lutra*), beaver (*Castor canadensis*), raccoon (*Procyon lotor*), and coyote (*Canis latrans*). Common small mammals in the project vicinity are Townsend chipmunk (*Eutamias townsendi*), Trowbridge shrew (*Sorex* *trowbridgei*), deer mouse (*Peromyscus maniculatus*), snowshoe hare (*Lepus americanus*), Douglas squirrel (*Tamiasciurus douglasi*), and northern flying squirrel (*Glaucomys sabrinus*). Bats that may inhabit the vicinity include little brown myotis (*Myotis lucifugus*), long-eared myotis (*Myotis evotis*), silver-haired bat (*Lasionycteris noctivagans*), and Yuma myotis (*Myotis yumanensis*).

Impacts

Potential impacts on fish and wildlife could occur if reasonably foreseeable future actions were to:

- Adversely affect a population by substantially reducing its numbers, causing a fish or wildlife population to drop below self-sustaining levels or causing a substantial loss or disturbance to habitat; such effects could include vehicle impacts and crushing, increased predation, habitat fragmentation, or loss of seasonal habitat;
- Have a substantial adverse impact on nesting migratory birds, including raptors, as protected under the Migratory Bird Treaty Act;
- Interfere with the movement of any resident or migratory fish or wildlife species, or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites; or
- Conflict with the wildlife management strategies of the FS.

Alternative A (No Action)

The No Action alternative would have no impact on fish and wildlife.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on fish and wildlife; however, anticipated future actions following leasing would potentially result in impacts on fish and wildlife within the lease areas from an estimated disturbance of approximately 25 acres. Potential impacts that would affect all wildlife would result from:

- Habitat disturbance – The fragmentation of wildlife habitat for species requiring large contiguous tracts, such as elk, mountain lion, and black bear, can be affected by site clearing, well drilling, construction of access roads and geothermal facilities, and maintenance and operational activities. These activities could cause disruption of breeding, foraging and migration, as well as mortality and injury of wildlife.
- Invasive Vegetation – Invasive species can affect wildlife by reducing habitat quality and species diversity and can affect foraging and breeding behavior.

- Injury or Mortality – Wildlife could be injured or killed during the clearing of roadways, vehicle staging, building construction, and other activities. Small mammals, reptiles and amphibians are most likely to be affected.
- Erosion and runoff – The effects of erosion include the loss of habitat for terrestrial species and increased turbidity which can directly affect the resident salmonid species found in the lease area.
- Fire – Vehicles, electrical lines, and cigarette smoking can all result in accidental fires. During fires wildlife can be killed or injured. After fires wildlife may be forced to move to other habitats or may be without suitable habitat for important behavioral activities.
- Noise – Construction and operation of geothermal facilities can produce noise far above normal ambient noise levels. Many species are sensitive to increases in noise that may cause disruption of breeding, migration, wintering, foraging, and other behavioral activities.
- Exposure to Contaminants – Vehicle fuel, hydraulic fluid, solvents, cleaners, and geothermal fluids can all be harmful to fish and wildlife. Accidental spills can contaminate soils and water and indirectly harm wildlife. Licensed herbicide use would likely be used to control vegetation around geothermal facilities and support structures. Spills of herbicides or acute exposure to herbicides can have adverse effects on wildlife.

Fish

Fish species in the East Fork Hood River and its tributaries, as well as headwater streams of The Dalles watershed could be affected by several activities. Impacts on fish and aquatic biota from development to the lease area would be linked to impacts on riparian habitats and immediately adjacent upland habitat. Ground disturbance, vegetation removal, ground water withdrawal, road construction and excavation, installation of structures and other facilities, such as transmission towers or pipelines, and release of water contaminants could affect fish species residing in streams in the project area, including cutthroat and rainbow trout and resident sculpin and dace species. Changes in hydrology, increased turbidity, changes in water quality (temperature, dissolved oxygen, pollutants, etc.), loss of riparian vegetation (an indirect aquatic food source), restriction of fish movement and migration, and changes in predator and human use of the aquatic habitat are all potential impacts associated with development of the lease area. The PEIS provides a more complete analysis of the potential impacts on fish resulting from geothermal activities, as well as impacts on riparian and wetland habitat that could affect fish and other aquatic biota.

Wildlife

Amphibians present in the lease area could be affected by any impacts that affect riparian habitat or water quality. Additionally, activities could result in direct mortality for amphibians and reptiles that are crushed by equipment or entrapped in underground burrows.

The lease sites provide habitat for a variety of migratory birds. Under the Migratory Bird Treaty Act, the FS is required to analyze the impacts of any action on migratory birds. The likelihood of disturbing nests of such birds is limited primarily to breeding and nesting seasons (spring and summer). Waterfowl, raptors, and small birds that depend on a particular forest types as a source of food or cover could be vulnerable to loss of habitat within the lease sites. Removing timber and other vegetative cover affects foraging and nesting behavior. Lease stipulations to avoid disturbance during the migratory bird nesting season, so as not to violate the Migratory Bird Treaty Act, would reduce the potential for significant impacts on migratory birds.

The lease areas provide foraging and wintering habitat for elk and deer. Habitat clearing and human activity associated with geothermal projects could disturb elk, displacing them temporarily or permanently from otherwise suitable foraging habitats in and adjacent to the areas proposed for leasing. Geothermal activities associated with development of the lease site would also result in increased human activity and potentially increase recreational use of the area, which could directly affect big game populations.

15.3.10 Threatened and Endangered Species and Special Status Species

Setting

This section provides an overview of threatened, endangered, and special status species and their habitats in the proposed lease area. Special status species are those identified by federal, state, or local agencies as needing additional management considerations or protection. The discussion of special status species is based primarily on analysis conducted for the Long Prairie Grazing Allotment Project located immediately adjacent to the areas proposed for leasing (US Forest Service 2005), as well as correspondence with NFS biologists regarding the lease area. Federal species are those protected under the Endangered Species Act and those that are candidates or proposed for listing under the act. State sensitive species are those considered sensitive by the Oregon Department of Fish and Wildlife. Federally listed species with record of occurrence in the proposed lease area are discussed below and listed in Table 15.3-5. Table 15.3-6 provides a record of FS sensitive species and management indicator species that may be present in the lease sites.

Table 15.3-5
Federally Listed Wildlife Species with Record of Occurrence and Potential to Occur in the Lease Area

Species	Habitat Present in Lease Areas?	Status		
		Federal	USFS – R6	State
Lower Columbia River Steelhead Trout	Immediately adjacent	Threatened	Sensitive	N/A
Middle Columbia River Steelhead Trout	Immediately adjacent	Threatened	Sensitive	N/A
Northern Spotted Owl	Yes	Threatened	N/A	Threatened
California Wolverine	Yes	Candidate	Sensitive	Threatened

Source: US Forest 2005, 2008f

Lower and Middle Columbia River Steelhead Trout

Lower and Middle Columbia River Steelhead Trout are the only anadramous fish known or expected to occur within the areas that may be affected by proposed leasing (US Forest Service 2008f). The presence of Lower Columbia River Steelhead has been recorded within the East Fork Hood River, and Middle Columbia River Steelhead Trout are found in the headwater of The Dalles watershed (US Forest Service 2008f). Both fish were listed under the Endangered Species Act threatened species on March 19, 1998. The threatened status of both of these species was reaffirmed on January 5, 2006 (National Marine Fisheries Service 2008).

Northern Spotted Owl

The northern spotted owl was federally listed as threatened in Washington, Oregon, and California in July 1990 (55 FR 26114); it is an Oregon State endangered species. Factors that contributed to the federal listing were the declining population trends, the loss of suitable forested habitats throughout the species range, and the lack of adequate regulatory mechanisms to protect existing habitat for the species. Critical habitat was designated for the northern spotted owl in 1992 (57 FR 1796). Spotted owls are strongly associated with mature and old growth forests for nesting, foraging, and roosting. Nesting and roosting occur in a variety of coniferous forest types characterized by moderate to high levels of canopy closure; high density of standing snags; large diameter overstory trees with deformities, such as broken tops and witches' brooms; and abundant coarse woody debris on the forest floor (Courtney et al. 2004). Old growth and Late-Successional Reserves are found throughout the lease sites and

Table 15.3-6
FS Sensitive Species and Management Indicator Species that May Occur in the Lease Sites

Common Name	Scientific Name	Potential Occurrence
Oregon Slender salamander	*Batrachoseps wrighti*	Y
Larch Mountain salamander	*Plethodon larselii*	Y
Cascade torrent salamander	*Rhyocotriton cascadae*	N
Pacific fisher	*Martes pennanti*	Y
Horned grebe	*Podiceps auritus*	Y
Bufflehead	*Bucephala albeola*	Y
Harlequin duck	*Histrionicus histrionicus*	Y
Peregrine falcon	*Falco peregrinus anatum*	N
Gray flycatcher	*Empidonax righti*	N
Puget oregonium	*Cryptomastix devia*	Y
Columbia oregonium	*Cryptomastix hendersoni*	Y
Dalles sideband	*Monadenia fidelis minor*	Y
Crater Lake tightcoil	*Pristiloma arcticum crateris*	Y
Evening fieldslug	*Deroceras hesperium*	Y
Mt Hood NF Management Indicator Species and Neotropical Birds		
Mule/Blacktailed Deer	*Odocoileus hemionus*	Y
Rocky Mountain Elk	*Cervus elaphus*	Y
Pine Martin	*Martes Americana*	Y
Pileated Woodpecker	*Dryocopus pileatus*	Y
Western Gray Squirrel	*Sciurus griseus*	Y
Wild Turkey	*Meleagris gallopavo*	Y
Snag and Down Log Associated Species	--	Y
Neotropical Migratory Birds	--	Y

SOURCE: US Forest Service 2005

provide suitable habitat for northern spotted owl; thus, their presence is assumed to occur in the sites proposed for leasing where suitable habitat occurs.

California Wolverine (Gulo Gulo)

Wilderness or remote country where human activity is limited appears essential to the maintenance of viable wolverine populations. High-elevation wilderness areas appear to be preferred in summer, which tends to effectively separate wolverines and humans. In winter, wolverines move to lower elevation areas that are snowbound with very limited human activity (Hornocker and Hash 1981). The last confirmed sighting of a wolverine in the Hood River Ranger

District was in 1990. The north side of Mount Hood is considered the most likely area for wolverines to den, if present within the area. The closest recent and confirmed wolverine sighting was two years ago on the Willamette National Forest by a USFS biologist (Dyke 2008). Because of the level of human activity present in the area and lack of confirmed presence, wolverines are not likely to be found in the lease area; however, their presence/absence from the lease sites on the north side of the Mt Hood can not be confirmed.

Critical Habitat

The Endangered Species Act requires the federal government to designate critical habitat for any species listed under the Act. Critical habitat is any specific area within the geographical area occupied by the species at the time of listing under the act that contains physical or biological features essential to conservation, and those features requiring special management considerations or protection; it also includes areas outside the geographical area occupied by the species that are determined essential to conservation.

Critical habitat designations must be based on the best scientific information available, in an open public process, within specific timeframes. Before designating critical habitat, careful consideration must be given to the economic impacts, impacts on national security, and other relevant impacts of specifying any particular area as critical habitat. The Secretary of Commerce may exclude an area from critical habitat if the benefits of exclusion outweigh the benefits of designation, unless excluding the area will result in the extinction of the species concerned.

The Endangered Species Act protects threatened and endangered species in several ways. Under Section 7, all federal agencies must ensure that any actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of a listed species, or destroy or adversely modify its designated critical habitat.

Plants

Two FS sensitive plant species are found in the lease area. They are elegant rockcress (*Arabis sparsiflora* var. *atrorubens*) and violet suksdorfia (*Suksdorfia violacea*).

Impacts

Title 16, United States Code, section 1531 *et seq.,* and Title 50, Code of Federal Regulations, part 17.1 *et seq.*, designate and provide for protection of threatened and endangered plant and animal species and their critical habitat. The administering agencies are the US Fish and Wildlife Service and the National Marine Fisheries Service. Consultation pursuant to Section 7 of the Endangered Species Act would be performed prior to any ground-disturbing activity.

Potential impacts on threatened and endangered and special status species could occur if reasonably foreseeable future actions were to:

- Violate the Endangered Species Act, the Migratory Bird Treaty Act, or applicable state laws; or
- Decrease a plant or wildlife species population to below self-sustaining levels.

Alternative A (No Action)
The No Action alternative would have no impact on special status species.

Alternative B (Proposed Action)
The Proposed Action would not have any direct impact on threatened and endangered and special status species; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Threatened and endangered species (including federal and state-listed species and FS and BLM special status species) could be affected as a result of 1) habitat disturbance, 2) the introduction of invasive vegetation, 3) injury or mortality, 4) erosion and runoff, 5) fugitive dust, 6) noise, 7) exposure to contaminants, and 8) interference with behavioral activities.

Because of the regulatory requirements of the Endangered Species Act and various state regulations, and the requirements specified in BLM Manual 6840 Special Status Species Management, FS sensitive species and management indicator species guidelines, and other resource-specific regulations and guidelines, appropriate survey, avoidance, and mitigation measures would be identified and implemented prior to any geothermal activities to avoid adversely affecting any sensitive species or the habitats on which they rely.

15.3.11 Historic and Scenic Trails

Setting

The Oregon section of the Pacific Crest National Scenic Trail traverses an area approximately five miles from the SWSW corner of Section 2 of OROR 017049. The Pacific Crest Trail spans 2,650 miles from Mexico to Canada, crossing through California, Oregon, and Washington. The trail passes through many historic and scenic areas and is mainly contained within National Forests and protected wilderness. The Mount Hood area is the chief attraction for the Oregon section of this trail, with 200 people annually attempting to complete the entire trail (US Forest Service 2008).

Impacts

Alternative A (No Action)
The No Action alternative would have no impact on historic or scenic trails.

Alternative B (Proposed Action)

The Proposed Action would have no direct impact on historic or scenic trails. Anticipated future actions following leasing are not expected to result in any impacts on the Pacific Crest Trail due to the lease sites being farther than the required one-mile buffer that is described in the PEIS to avoid impacts.

15.3.12 CULTURAL RESOURCES

Setting

Cultural resources are past and present expressions of human culture and history in the physical environment and include prehistoric and historic archaeological sites, structures, natural features, and biota that are considered important to a culture, subculture, or community. Cultural resources also include aspects of the physical environment that are a part of traditional lifeways and practices and are associated with community values and institutions.

As in the PEIS, discussions relevant to cultural resources in this document are found in three sections. Traditional cultural resources and traditional cultural properties are addressed in Section 15.3.13, *Tribal Interests and Traditional Cultural Resources*. Section 15.3.11 addresses *Historic and Scenic Trails*. Cultural resources in this section include the physical remains of prehistoric and historic cultures and activities.

Ceded Lands of The Confederated Tribes of Warm Springs (Dryden 2008a) in the Molala extended-family groups wintered west of the Cascades summit in low elevations. Winter villages included semi-excavated wood plank houses. At other times of the year, individuals and families ranged to a variety of harvest localities from low-elevation prairies to collecting and hunting grounds in the High Cascades. Summer houses were constructed of bark or thatched-rush and resembled winter houses but were not excavated. Large and small terrestrial mammals were hunted for subsistence, primarily deer and elk. The bow and arrow, snares, deadfalls, pitfalls, stalking, and tracking by dog were all used for hunting. Fish were hunted with harpoon, basketry traps, and weirs in the rivers, while vegetal subsistence resources were collected in the prairies, savannas, and high elevations (Zenk and Rigsby 1998).

A variety of historic-era activities have been documented within the region of the pending lease application sites. These included fur trapping and trade, mining, agriculture, fishing, emigration and settlement by Euro-Americans, missionization, and establishment of trails and railroads. Lewis and Clark may have been the first Euro-Americans to contact the Molalas; however, there is sufficient documentation to confirm that contact had been made by the 1840s when Euro-Americans began to settle in the Willamette Valley, resulting in occasional conflicts between settlers and Molala people. The Dayton and Molala treaties of 1855 provided for the removal of Molalas to the Grand Ronde

Reservation east of the project area. Primarily Northern Molalas moved to the reservation, but many others moved to other reservations in Oregon or maintained their own residences (Zenk and Rigsby 1998). The Warm Springs and Wasco bands were relocated to the Confederated Tribes of Warm Springs Reservation. As noted in Section 15.3.11, the Oregon Trail passes through the region. Associated with this trail is the National Register of Historic Places (NRHP)-listed Barlow Road National Historic District also within the region (Dryden 2008b).

Data on cultural resources of the proposed lease area were provided in May 2008 by Michael Dryden, East Zone Archaeologist for the Mount Hood NF. The basic records search conducted revealed there are ten previously recorded cultural resource sites within lease application site OROR 017053, four within OROR 017327, five within OROR 017052, two within OROR 017051, and four within OROR 017049, including a NRHP-listed historic district and its contributing elements. Sites OROR 017327, 017052, and 017053 have been almost entirely surveyed while the remaining two leases application sites have had only minimal, scattered coverage by previous surveys.

Resources within OROR 017053 are all historic-era sites. Seven of these are buildings and building remains: FS Site Nos. 666EA0179 (Don's Cabin), 666EA0161 (Cooper Spur Warming Hut), 666EA0199 (collapsed cabin), 666EA0200 (collapsed cabin), 666EA0083 (Homestead Inn), 666EA0085 (cabin remains), and 666EA0081 (cabin remains). Two of the Euro-American sites are ditches: FS Site Nos. 666EA0050 (Glacier Ditch) and 666EA0079 (portion of Glacier Ditch). The final site is a hunter's campsite, FS Site No. 666EA0180. Of the sites within Lease OROR 017053 only FS Site Nos. 666EA0161 and 666EA0180 have been evaluated for NRHP eligibility; the former has been determined eligible for the NRHP and the latter ineligible. All other sites within the lease area are unevaluated for NRHP eligibility and are therefore treated as eligible. Almost the entire lease area has been previously surveyed with current survey methods.

Two of the recorded resources within Lease OROR 017327 are pre-contact-era and two are Euro-American. These include the pre-contact sites FS Site Nos. 666NA0080 and 666NA0063, both locations of peeled cedar trees. The former has not been evaluated for NRHP eligibility and is therefore treated as eligible. FS Site No. 666NA0063 has been evaluated and was determined ineligible for the NRHP. The two Euro-American resources within Lease OROR 017327 are FS Site Nos. 666EA0087 and 666EA0088, both cabin remains. Neither has been evaluated for NRHP eligibility. Almost the entire lease area has been previously surveyed with current survey methods.

Lease OROR 017052 includes three Euro-American sites and two pre-contact sites. The Euro-American sites include FS Site Nos. 666EA0115, a sheepherder's grave, 666EA0058, Mill Creek Buttes Lookout, and 66EA0001, Glade rock piles.

The pre-contact sites include FS Site Nos. 666NA0301, a quarry and lithic scatter, and 666NA0303, a lithic isolate. None of the sites within this lease have been evaluated for NRHP eligibility and are therefore treated as eligible. Almost the entire lease area has been previously surveyed with current survey methods.

The two resources within OROR 017051 are both pre-contact sites. These include FS Site Nos. 666NA0078, a spring ditch, and 666NA0068, a stripped cedar tree. Neither site has been evaluated for NRHP eligibility. Less than ten percent of the lease area has been previously surveyed with current survey methods.

Recorded resources within Lease OROR 017049 are all Euro-American. Most of the lease is within the boundaries of the Cloud Cap-Tilly Jane National Historic District and includes various unrecorded contributing resources to the district. Additionally, FS Site Nos. 666EA0184, 666EA0100, and 666EA0029 are within the lease. FS Site No. 666EA0184 is a dispersed can dump site and FS Site No. 666EA0100 is the Cloud Cap Wagon Road. Both have been determined eligible for the NRHP. FS Site No. 666EA0029 is the location of a 1959 jet airplane crash that has been determined ineligible for the NRHP. Very little (less than ten percent) of the lease area has been previously surveyed.

Consultation with federally recognized tribes that are affiliated with the lease area, including the Warm Springs Reservation, was initiated on September 12, 2007 to identify and assess historic properties that may be affected by the undertaking. No responses from local tribes have been received as of the date of publication; however consultation is considered on-going.

Until consultation with local Native Americans has been completed, it is unknown if there are Native American sites or sacred sites within or adjacent to the lease areas. The presence of cultural resources within portions of the leases not previously surveyed is also possible. Table 15.3-7 summarizes available data on the cultural resources of the proposed lease areas.

Table 15.3-7
Recorded Cultural Resources in the Proposed Lease Areas

Lease OROR	Surveys (Percent)	NRHP-listed sites	NRHP-eligible sites	NRHP-ineligible sites	Unevaluated sites (Treated as NRHP-Eligible)
017049	8	1	2	1	N/A
017051	1	N/A	N/A	N/A	2
017052	99	N/A	N/A	N/A	5
017053	96	N/A	1	1	8
017327	98	N/A	N/A	1	3

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on cultural resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on cultural resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Completion of the Section 106 process of the National Historic Preservation Act requires the FS to consult with the State Historic Preservation Office, tribes and other parties to identify and assess historic properties affected by the undertaking and to develop measures to avoid, minimize, or mitigate any adverse effects of the undertaking on historic properties.

Given the density of sites within the lease areas and the presence of NRHP-listed and –eligible resources within the Mt. Hood area leases, impacts on cultural resources could occur from subsequent permitted geothermal exploration, drilling operations and development, utilization and reclamation and abandonment through ground-disturbing activities, unauthorized actions and alterations to setting and cultural landscapes. The nature of these impacts is described in Chapter 4 of Volume I of the PEIS. Additionally, as described in Chapter 2 of Volume I of the PEIS, various areas of cultural resources would have No Surface Occupancy stipulations: National Landmarks, National Register Districts, NRHP-listed and –eligible sites and their associated landscapes, traditional cultural properties, Native American sacred sites, and areas with important cultural and archaeological resources. Areas of potential effect would include access roads, well pads, power plant footprints, pipeline and transmission line routes, and construction staging areas as well as the boundaries of cultural resources those facilities cross and the aspects of setting that contribute to significance. These areas of potential effect would be developed at the project-specific level and would require inventories, evaluations, and appropriate treatments as outlined in the best management practices of Appendix D in Volume III of the PEIS. Under these cultural resources best management practices, the FS would also conduct Section 106 consultations with the State Historic Preservation Office, Native American tribes with ties to the project area, and local historic preservation groups to identify the presence and significance of cultural resources within or adjacent to the lease area and assess the level of impact of geothermal leasing and development on those resources. Project-specific impacts after leasing would be reduced by implementing these best management practices.

15.3.13 Tribal Interests and Traditional Cultural Resources

Setting

Tribal interests include economic rights such as Indian trust assets, and resource uses and access guaranteed by treaty rights. Traditional cultural resources or properties include areas of cultural importance to contemporary communities, such as sacred sites or resource gathering areas. While most commonly considered in the context of Native Americans and Native Alaskans, there are traditional cultural resources associated with other ethnic or socially linked groups.

The lease area is within the Ceded Lands of The Confederated Tribes of Warm Springs (Dryden 2008a) in the Plateau culture region, as described in the Appendix I of the PEIS. Zenk and Rigsby (1998) provide an ethnographic overview of the project area within the larger Plateau culture region. The leases are considered to be within the traditional territory of the Warm Springs and Wasco bands (Dryden 2008b), Molala-speaking groups. Within the traditional territory, the project area is in an area where the Northern Molala dialect was spoken but is immediately adjacent to the northern boundary of the Molala territory. Traditional collecting and hunting grounds were typically located in the High Cascades.

The Dayton and Molala treaties of 1855 provided for the removal of Molalas to the Grand Ronde Reservation east of the project area. Primarily Northern Molalas moved to the reservation, but many others moved to other reservations in Oregon or maintained their own residences (Zenk and Rigsby 1998). The Warm Springs and Wasco bands were relocated to the Confederated Tribes of Warm Springs Reservation (Dryden 2008b).

The lease areas are entirely within the Ceded Lands of the Confederated Tribes of the Warm Springs Reservation. Although there are no known traditional cultural properties within the lease areas (Dryden 2008a), this location makes the likelihood for such resources high. Additionally, there are known huckleberry fields within OROR 017049 and 017327 that have not been defined or mapped. Huckleberry fields are considered to be Native American resource sites by local Native Americans. These fields therefore have the potential to be cultural properties.

Tribes with ties to the lease area include the Confederated Tribes of Warm Springs Reservation of Oregon. Consultation with federally recognized tribes that are affiliated with the lease area, including the Warm Spring Reservation, was initiated on September 12, 2007 to identify and assess tribal concerns and traditional resources that may be affected by the undertaking. No responses from the tribes have been received as of the date of publication; however, the consultation process is considered on-going. While many traditional cultural resources are well known, some locations or resources may be privileged information that is restricted to specific practitioners or clans. For tribes, maintaining confidentiality and customs regarding traditional knowledge may take precedence over identifying and evaluating these resources, unless they are in imminent danger of damage or destruction.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on tribal interests and traditional cultural resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on tribal interests and traditional cultural resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Impacts on tribal interests and traditional cultural resources are assessed using the criteria found in Chapter 4 of Volume I of the PEIS. Because issuing geothermal leases confers on the lessee a right to future exploration and development of geothermal resources within the lease area, it is a commitment or granting of a right that may interfere with other uses or interests. Although no tribal interests or concerns have been identified by the consultation process, the presence of huckleberry fields within the lease areas and the location of the leases within the Ceded Lands of the Confederated Tribes of Warm Springs Reservation make the likelihood of Native American resources or areas of concern high. The process of Native American consultation is considered on-going and such resources may be identified in the future by tribes. Impacts on tribal interests would be minimized or avoided by implementing best management practices included in Appendix D of Volume III of the PEIS for each phases of the Reasonably Foreseeable Development scenario, as described in Chapter 2 of Volume I of the PEIS.

For traditional cultural resources, completion of the Section 106 process of the National Historic Preservation Act requires the FS to consult with the State Historic Preservation Office, tribes and other parties to identify and assess historic properties affected by the undertaking and develop measures to avoid, minimize, or mitigate any adverse effects of the undertaking on historic properties, which include traditional cultural properties. No traditional cultural resources have been identified by consulted tribes thus far, but consultation is considered on-going. Additionally, archaeological resources such as those discussed in Section 15.3.12 *Cultural Resources* are often considered traditional resources by tribes.

Impacts on traditional cultural resources could occur from subsequent geothermal exploration, drilling operations and development, utilization, and reclamation and abandonment through ground-disturbing activities, unauthorized actions and alterations to setting and cultural landscapes. The nature of these impacts and mitigations are described in Chapter 4 of Volume I of the PEIS. Areas of potential effect would include access roads, well pads, power plant footprints, pipeline and transmission line routes, and construction staging areas as well as the aspects of setting that contribute to significance. These areas of potential effect would be developed at the project-specific level and would require inventories, evaluations, and appropriate treatments as outlined in the best management practices of Appendix D in Volume III of the PEIS. Under these cultural resources best management practices, the FS would also conduct Section 106 consultations with the State Historic Preservation Office, Native American tribes with ties to the project area, and local historic preservation groups to identify the presence and significance of cultural resources within or adjacent to the lease area and assess the level of impact of geothermal leasing and development on those resources. Project-specific impacts after leasing would be reduced by implementing these best management practices.

15.3.14 VISUAL RESOURCES

Setting

This section describes the visual resources in the region of influence, which is defined as the areas within and immediately surrounding the proposed lease areas. Described below is the method for managing scenic resources and the visual landscape of the lease areas.

The scenery of the Forest is managed through the application of the Visual Management System (Agricultural Handbook- 462, National Forest Landscape Management, Volume 2, Chapter 1, The Visual Management System). The Visual Management System was adopted by the Forest Service in 1974. The key component of the Visual Management System is the establishment of Visual Quality Objectives within the Land and Resource Management Plan.

There are five differing levels of Visual Quality Objectives: Preservation, Retention, Partial Retention, Modification, and Maximum Modification.

The following is a brief description of the five Visual Quality Objectives:

- Preservation – Allows ecological change only. Management activities are prohibited except for very low visually impacting recreation facilities.
- Retention – Management activities may not be visually evident. Contrasts in form, line, color and texture must be reduced during or immediately after the management activity.
- Partial Retention – Management activities must remain visually subordinate to the characteristic landscape. Associated visual

impacts in form, line, color and texture must be reduced as soon after project completion as possible but within the first year.

- Modification – Management activities may visually dominate the characteristic landscape. However, landform and vegetative alterations must borrow from naturally established form, line, color or texture so as to blend in with the surrounding landscape character. The objective should be met within one year of project completion.
- Maximum Modification – Management activities including vegetative and landform alterations may dominate the characteristic landscape. However, when viewed as background they must visually appear as natural occurrences within the surrounding landscapes or character type. When viewed as foreground or middle ground, they may not appear to completely borrow from naturally established form, line, color, or texture. Alterations may also be out-of-scale or contain detail which is incongruent with natural occurrences as seen in foreground or middle ground. Reduction of contrast should be accomplished within five years.

Some of the lease areas have Partial Retention and Retention Visual Quality Objectives. The southwestern areas are adjacent to the Mount Hood Wilderness area. The lease areas contain scenic viewsheds, a special interest area (in the westernmost lease areas), winter recreation areas (around Cooper Spur Mountain Resort), and special emphasis watersheds (in the easternmost lease areas).

According to the Forest Plan, the Forest offers a number of scenic vistas, a snowcapped mountain, waterfalls, crystal clear streams, blue lakes, and meadows of many-colored flowers (US Forest Service 1990). These visual resources attract tourists from near and far, as well as nearby residents.

The proposed lease areas are approximately 4 to 12 miles northeast of the summit of Mount Hood (approximately 11,200 feet above mean sea level), just south of Upper Hood River Valley, and straddle Highway 35 and East Fork Hood River. Other watercourses in the lease areas are Crystal Spring Creek, Tilly Jane Creek, Doe Creek, Cold Spring Creek with Tamanawas Falls (approximately 100 feet tall), Ash Creek, Polallie Creek, Puppy Creek, Dog River, Crow Creek, Alder Creek, and South Fork Mill Creek. Prominent peaks near the lease areas are Shellrock Mountain (approximately 4,400 feet), Mill Creek Buttes (approximately 4,800 feet), and Bluegrass Ridge (approximately 5,600 feet).

The foothills and canyons of the lease areas are mostly covered with a coniferous forest of varying heights and maturity, except where a patchwork of clear cuts occurs. A web of dirt roads for logging covers the lease areas.

Human-made modifications to the visual landscape are limited to roads of various conditions and recreation areas. Hiking and backpacking activities occur in the lease areas. Cooper Spur Mountain Resort is adjacent to lease OROR 017053. In addition to downhill skiing, the resort and surrounding areas are also used for cross country skiing and snowshoeing. Sherwood Campground is also adjacent to the same lease. With the exception of Highway 35, there are no sources of light in the lease areas.

Highway 35 is a National Scenic Byway and an Oregon State Scenic Byway (US Department of Transportation 2008a). It is 105 miles long and offers views of deep gorges, unique geology, waterfalls, temperate rain forests, wild rivers, pastoral valleys, and the last leg of the Oregon Trail, the Barlow Road (US Department of Transportation 2008b). The visual corridor along Highway 35 has a Visual Quality Objective of Retention.

Portions of the area northeast of the summit of Mount Hood are proposed for special designations. The remarkable visual resources in these areas attract tourists and residents. The following lists the special designations, which involve scenic resource protection:

- Tilly Jane Wilderness Area;
- Cloud Cap Wilderness Area;
- Bluegrass Ridge Wilderness Area;
- Shellrock Mountain National Recreation Area; and
- East Fork Hood River Wild and Scenic River.

Impacts

Mount Hood National Forest was not able to provide Visual Quality Objective data for this analysis. For the purpose of this analysis, it is assumed that all of the lease areas on Forest Service land have either Partial Retention or Retention Visual Quality Objectives.

Alternative A (No Action)

The No Action alternative would have no impacts on visual resources. There would be no changes to visual resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on visual resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. The potential risk of changes affecting visual resources is assessed for five significance criteria, which are described in the PEIS. Future actions based on the Reasonably Foreseeable Development scenario could result in changes that impact visual resources.

Future geothermal development activities could involve new structures, roads, and operations that are described in the Reasonably Foreseeable Development scenario. The new structures, roads, and operations would alter the characteristic landscape and be sources of light and glare. Depending on their exact location, they could also diminish scenic views afforded individuals participating in recreation activities or traveling through the area. These impacts would be noticeable, because they would be in areas that are relatively undeveloped and would be near areas where various recreation activities occur year-round. The impacts would also be near a scenic byway and the Mount Hood Wilderness Area. Although stipulations outlined in Appendix B of the PEIS would minimize these impacts, geothermal resource development activities would be visually evident. Changes to visual resources based on the Reasonably Foreseeable Development scenario would result in impacts on visual resources that would not be consistent with Retention Visual Quality Objectives.

It is assumed the stipulations would result in positioning new structures, roads, and operations in the landscape so they would remain visually subordinate to the characteristic landscape. It is also assumed geothermal development activities do not occur in areas proposed for special designation due to the outstanding scenery associated with the proposed designations and would comply with scenic byway standards. As a result, changes to visual resources based on the Reasonably Foreseeable Development scenario would result in impacts on visual resources that would be consistent with Partial Retention Visual Quality Objectives.

15.3.15 Socioeconomics and Environmental Justice

Setting

The lease area covers approximately 9,200 acres within Hood River County, Oregon. The county was selected as the ROI for socioeconomic analysis as the impacts of leasing are likely to occur within this region. A summary of the population, housing, employment, local school data and low-income and minority populations for the county is provided based primarily on data from Census 1990 and 2000 population, demographic and housing information (US Census Bureau 1990, 2000).

Population

The 2006 estimates for county population are 21,533 (US Census Bureau 2008), which is a 5.5 percent increase over 2000 census levels. From 1990 to 2000, the population increased 17 percent (US Census Bureau 1990, 2000).

Housing

In 1990 approximately 7,589 housing units existed, of which 6,425 were occupied and 3,990 were owner-occupied with a homeowner vacancy rate of 1.5 percent and a rental vacancy rate of 9.7 percent. In 2000 total housing units were 7,818, of which 7,248 were occupied and 4,702 were owner-occupied with a homeowner vacancy rate of 1.4 percent and a rental vacancy rate of 3.7 percent (US Census Bureau 1990, 2000).

Employment

In 1990 the total work force was 8,461, with 728 (or 8.6 percent) of those people being unemployed. Unemployment fell by 2000, with a total workforce of 10,196 an unemployment rate of 4.4 percent. Median household income was $38,326 in 2000 and $29,009 in 1990 (US Census Bureau 1990, 2000).

In 1999, the industries employing the largest percentage of the population were education, health and human services (18.5 percent); agriculture, forestry and mining (14.0 percent); retail trade (11.5 percent); and arts, entertainment, recreation, accommodation and food services (10.3 percent) (US Census Bureau 2000).

While farming and forestry have historically been the dominant industries, recreational development and the sale of land for construction of second homes have become increasingly important in the local economy (US Forest Service 1990).

Schools and Public Infrastructure

In 2000, 4,269 students were enrolled in K-12 education in Hood River County. This is an increase from 1990, when 3,020 students were enrolled. Future enrollment is expected to follow general population trends (US Census Bureau 1990, 2000).

Environmental Justice

In Hood River County, 70.7 percent of the population identified themselves as White of non-Hispanic descent. The largest minority population represented in the county is the Hispanic /Latino population, which makes up approximately 25 percent of the population (US Census Bureau 2000). Additional details for the racial and ethnic groups represented in the county are provided in Table 15.3-8.

In 2000, 14.2 percent of the population surveyed was below the poverty level. This is a slight decrease from 1990, when 15.6 percent of individuals were below the poverty level. The unemployment numbers in Hood River County are approximately the same as those seen at the State level (US Census Bureau 1990, 2000).

Table 15.3-8
Race/Ethnicity in Hood River County

	1990	2000	Percent Change
Total Population	16,903	20,411	20.7
White	15,346	16,099	4.9
Black/African American	46	117	154
American Indian/ Alaskan Native	201	229	13.9
Asian	305	301	-1
Pacific Islander*	N/A	25	N/A
Other	1005	3137	212
Two or more*	N/A	503	N/A
Hispanic or Latino**	2,752	5107	85.5

Source: US Census Bureau 1990, 2000.
* Not reported on1990 census: Asian and Pacific Islanders were one group and more than one race was not an option.
** In combination with other race. Totals may add to more than 100 percent as individuals can report more than one race.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on existing socioeconomics in Hood River County. No impacts would occur to minority or low-income populations.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on socioeconomics or environmental justice; however, geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Impacts include a potential increase in jobs and decrease in unemployment in Hood River County due to construction and operations and maintenance jobs at newly developed geothermal plants. Geothermal development would also be a positive stimulus to the local economy through tax revenues for Hood River County and the State of Oregon.

A general discussion of the impacts of geothermal leasing for a 50-MW plant is provided in Section 4 of the PEIS under *Socioeconomics and Environmental Justice*. Similar impacts to those discussed in the PEIS are likely for this lease area.

Due to the lack of residential areas in the vicinity of the lease area, there would be no disproportionate impacts on minority or low-income populations.

15.3.16 NOISE

Setting

Current sources of noise in the lease areas are limited to wind, dispersed recreational use, traffic from roads within the leasing site boundaries, and wildlife. Sources of noise originating outside of the lease areas but affecting the lease areas include traffic from adjacent roads, air traffic, and activity from an adjacent recreational facility. Sensitive noise receptors are generally considered to be homes, hospitals, schools, and libraries. One resort lies within one mile of the lease site. No other buildings or developments are present within one mile of the lease site.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on noise.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on noise; however, geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. No sensitive receptors have been identified within or immediately adjacent to the lease areas, so noise impacts are expected to be minimal.

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Chapter 16

Willamette National Forest

Salem District

Analysis for Pending Lease Application:

OROR 054587

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SECTION 16.1 INTRODUCTION

16.1.1 INTRODUCTION

This lease-specific analysis describes the environmental effects of leasing approximately 1,115 acres of National Forest land within the Detroit District of the Willamette National Forest and the BLM Salem Field Office/District to private industry for the development of geothermal resources.

This lease-specific analysis serves as an information resource to aid decision-makers in determining whether these lands are appropriate for leasing under FS and BLM management policies and existing environmental regulations.

The lease site is within the Detroit Ranger District of the Willamette National Forest, which is the surface management agency for the site. Subsurface mineral rights are managed by the BLM Salem Field Office. The BLM issues leases with the consent of the FS (Regional Forester upon recommendation from the Willamette NF Supervisor) for the lands under application on the Willamette NF.

16.1.2 LOCAL REGULATORY CONSIDERATIONS

The pending lease application sites are located within Linn County, Oregon and are subject to state and local regulations, as described below.

State of Oregon Renewable Portfolio Standard Program

The Oregon Renewable Portfolio Standard Program is an Oregon law that requires the largest utilities in Oregon to provide 25 percent of their retail sales of electricity from clean, renewable sources of energy in 2025. Smaller utilities will have similar, but lesser, obligations. Geothermal energy is included in the definition of renewable resources under the program.

Willamette National Forest Land and Resources Management Plan (1990)

The Willamette National Forest Land and Resources Management Plan (Forest Plan) guides all natural resource management activities and establishes management standards and guidelines for the Willamette National Forest. It describes resource management practices, levels of resource production and management, and the availability and suitability of lands for resource management.

The Forest Plan identifies the following resource management goals that apply to geothermal leasing:

- Minerals and Energy – Facilitate the exploration and development of mineral and energy resources where available on the Forest in a manner compatible with other resource values.
- Economic – Generate revenues from permits, leases, user fees, and product receipts.
- Human and Community – Promote area economic well-being by using Forest resources to generate revenues for local counties and providing direct or indirect employment opportunities.
- Wildlife, Fish, and Plants – Minimize conflicts of human activities and occupancy with wildlife, fish, and plant habitats, including impacts of…road construction…

The Forest Plan identifies the following forest-wide standards and guidelines that apply to geothermal activity:

- FW-296 – Leasable minerals shall be administered in accordance with the Minerals Land Leasing Act of 1920 as amended and the Federal Onshore Oil and Gas Leasing Reform Act of 1987.
- FW-297 – Permits for leasable minerals shall provide for protection and rehabilitation of surface resources.
- FW-298 – Applications for permits and leases shall be evaluated in an environmental analysis.
- FW-299 – A "no-surface-occupancy" stipulation on leases should be considered when:
  - Surface occupancy would cause significant resource disturbance which could not be mitigated by any other means;
  - Where resource impacts would be irreversible or irretrievable; or
  - The activity is incompatible with surface management objectives.
- FW-300 – Off-lease support facilities and/or activities may be authorized by appropriate NFS land use permits.
- FW-301 – Geothermal resources shall be administered in accordance with the direction established by the final decisions in

the following environmental analysis: Breitenbush Area Final Environmental Impact Statement, 1978; Geothermal Leasing on Nonwilderness Areas Environmental Assessment, 1982; Belknap-Foley Final Environmental Impact Statement, 1981. These documents are on file at the Willamette National Forest Supervisor's Office.

The Forest Plan also includes Standards and Guidelines for rivers determined to be eligible into the National Wild and Scenic River System. The Forest Plan mandates that such rivers, until suitability has been determined, shall be managed within a quarter mile of each side to meet Standards and Guidelines prescribed for Wild and Scenic River Management Area 6c. The Standards and Guidelines mandate that activities shall not preclude the river from potential inclusion into the National Wild and Scenic Rivers System.

Salem Resource Management Plan (1995)

The lease area is within the BLM Salem District. Public lands and geothermal resources within this district are managed by the Salem Resource Management Plan (Salem RMP). The vision of the Salem RMP is to manage land and natural resources under its jurisdiction in western Oregon to maintain healthy, diverse, and productive ecosystems so that present and future generations may continue to benefit from the public lands. There are several basic principles supporting this vision:

- Natural resources can be managed to provide for human use and a healthy environment;
- Resource management must be focused on ecological principles to reduce the need for single resource or single species management;
- Stewardship, the involvement of people working with natural processes, is essential for successful implementation;
- The BLM cannot achieve this vision alone but can, by its management processes and through cooperation with others, be a significant contributor to its achievement; and
- A carefully designed program of monitoring, research and adaptation will be the change mechanism for achieving this vision.

The Energy and Mineral Resource Program with in the Salem RMP states the following three objectives:

- Maintain exploration and development opportunities for leasable and locatable energy and mineral resources.

- Provide opportunities for extraction of salable minerals by other government entities, private industry, individuals, and nonprofit organizations.
- Continue to make available mineral resources on the reserved federal mineral estate.

The Program estimates that there are approximately 392,200 acres of leasable mineral resources available for exploration and development within the Salem District. An additional 27,800 acres of private land with reserved federal mineral estate (also referred to as federal subsurface mineral estate) are estimated to be within the Salem District.

The program includes the following Management Actions/Direction regarding leasable minerals:

- Use standard and special stipulations for oil, gas, geothermal, and coal leases to protect fragile areas or critical resource values (Appendix F of the Salem RMP includes a list of mineral restrictions by resource value). Special stipulations may include:
  - Seasonal restrictions to protect resources such as critical wildlife habitat, prevent excessive erosion, etc.;
  - Controlled surface use stipulations to protect valuable resources in small areas; and
  - No surface occupancy stipulations to protect valuable resources scattered over a large area while still providing an opportunity for exploration and development.
- Waive special stipulations if the objective of a stipulation could be met in another way.
- Provide opportunities for coal and geothermal exploration and development in areas with potential for occurrence. Geothermal activities are regulated under 43 Code of Federal Regulations 3200.
- Allow no leasing on lands within incorporated cities. Tracts within the planning area affected by this type of closure are located in Salem and Willamina.

The Bureau of Land Management is currently revising the Salem RMP to align it with the Northwest Forest Plan. The revised plans are to be completed in the fall of 2008.

Northwest Forest Plan

The Northwest Forest Plan (NWFP) is an overall vision for the Pacific Northwest that would produce timber products while protecting and managing impacted species. The Plan focuses on the following five key principles:

- Never forget human and economic dimensions of issues;
- Protect long-term health of forests, wildlife, and waterways;
- Focus on scientifically sound, ecologically credible, and legally responsible strategies and implementation;
- Produce a predictable and sustainable level of timber sales and non-timber resources; and
- Ensure that Federal agencies work together.

The mission of the NWFP is to adopt coordinated management direction for the lands administered by the FS and the BLM and to adopt complimentary approaches by other Federal agencies within the range of the northern spotted owl. The management of these public lands must meet dual needs: the need for forest habitat and the need for forest products. With the signing of the Northwest Forest Plan Record of Decision in 1994, a framework and system of Standards and Guidelines were established, using a new ecosystem approach to address resource management.

The NWFP includes the following Standards and Guidelines that apply to geothermal development in Late-Successional Reserves:

> Mining - The impacts of ongoing and proposed mining actions will be assessed, and mineral activity permits will include appropriate stipulations (e.g., seasonal or other restrictions) related to all phases of mineral activity. The guiding principle will be to design mitigation measures that minimize detrimental effects to late-successional habitat.

The NWFP includes the following management measures that apply to geothermal development in Riparian Reserves:

MM-1. Require a reclamation plan, approved Plan of Operations, and reclamation bond for all minerals operations that include Riparian Reserves. Such plans and bonds must address the costs of removing facilities, equipment, and materials; recontouring disturbed areas to near pre-mining topography; isolating and neutralizing or removing toxic or potentially toxic materials; salvage and replacement of topsoil; and seedbed preparation and revegetation to meet Aquatic Conservation Strategy objectives.

MM-2. Locate structures, support facilities, and roads outside Riparian Reserves. Where no alternative to siting facilities in Riparian Reserves exists, locate them in a way compatible with Aquatic Conservation Strategy objectives. Road construction will be kept to the minimum necessary for the approved mineral activity. Such roads will be constructed and maintained to meet roads management standards and to minimize damage to resources in the Riparian Reserve. When a road is no longer required for mineral or land management activities, it will be closed, obliterated, and stabilized.

MM-4. For leasable minerals, prohibit surface occupancy within Riparian Reserves for oil, gas, and geothermal exploration and development activities where leases do not already exist. Where possible, adjust the operating plans of existing contracts to eliminate impacts that retard or prevent the attainment of Aquatic Conservation Strategy objectives.

MM-6. Include inspection and monitoring requirements in mineral plans, leases or permits. Evaluate the results of inspection and monitoring to effect the modification of mineral plans, leases and permits as needed to eliminate impacts that retard or prevent attainment of Aquatic Conservation Strategy objectives.

16.1.3 Scope of Analysis and Approach

This lease-specific analysis incorporates by reference the programmatic analysis presented in Volume I. This analysis examines the pending lease application site, describes the Reasonably Foreseeable Development scenario for this site, examines the existing environmental setting, and describes the potential direct and indirect impacts that issuing the lease at this sites, and anticipated future actions following leasing, would have on the human and natural environment.

This report focuses on specific key resource concerns in the lease area, and incorporates by reference the impacts described in the PEIS. Decision-makers should consider both the impacts described in this lease-specific analysis, in addition to those described in the main body of the PEIS. The analysis presented here does not reiterate the details of impacts identified in the PEIS, but rather refers to them as they arise in the impact analysis for pending lease application sites addressed here. Willamette National Forest staff members were contacted during the preparation of this lease-specific analysis to help identify local resource concerns.

16.1.4 Cumulative Actions

Consultation with the Willamette National Forest did not identify any projects that would cumulatively contribute to impacts within the project area.

SECTION 16.2
PROPOSED ACTION AND ALTERNATIVES

16.2.1 INTRODUCTION

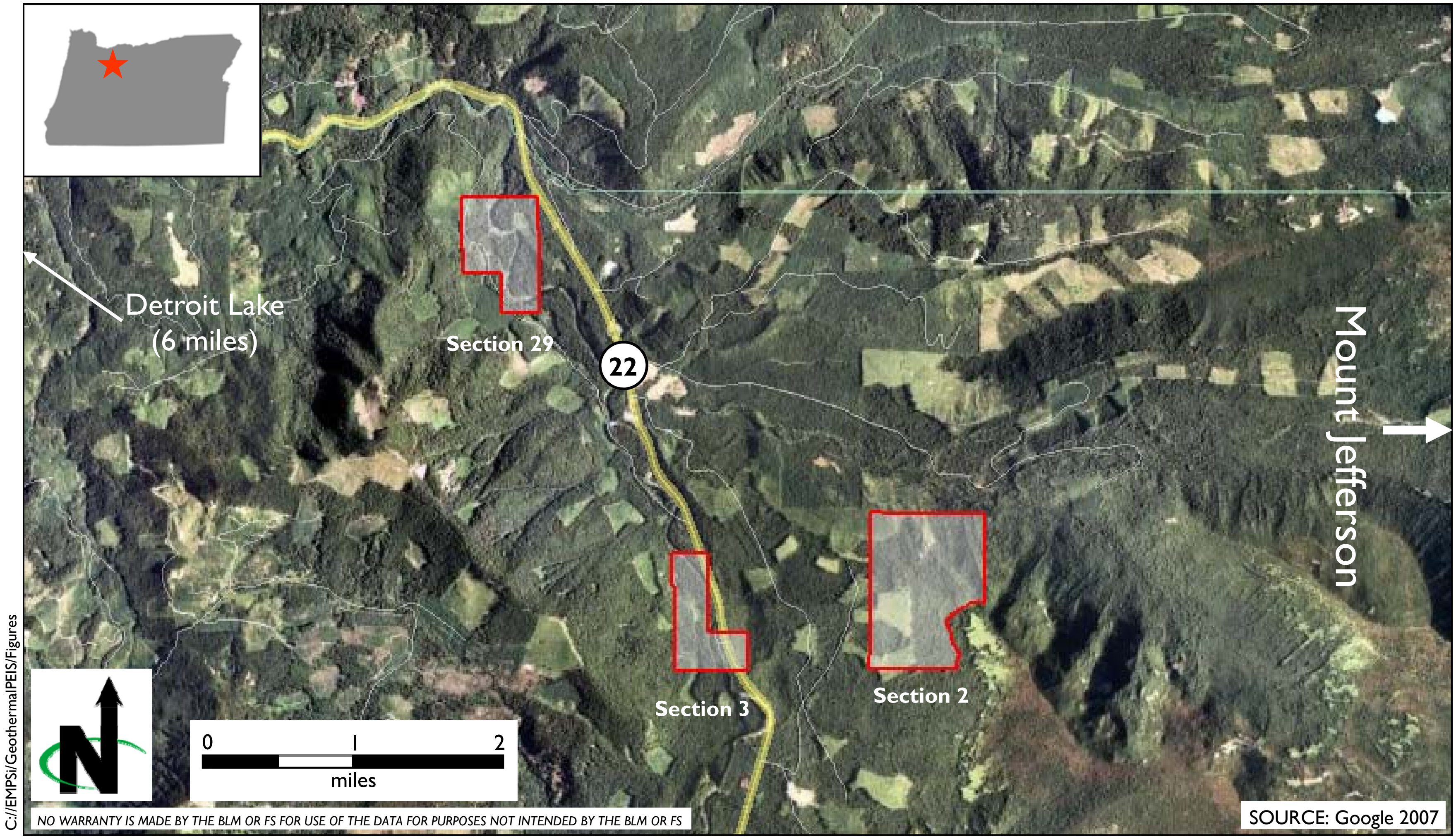
This chapter provides the details of the proposed action, alternatives to the proposed action, and an overview of the reasonably foreseeable develop (Reasonably Foreseeable Development) scenario for pending lease application site OROR 054587.

16.2.2 PROPOSED ACTION

The proposed action is for (1) the Forest Service to issue a consent determination to the BLM to issue the lease to the applicant for three areas within the Willamette National Forest and Salem BLM District; and (2) the BLM to issue said lease. The 1,115.280 acres of land are in a river valley centered on the North Santiam River, and are located approximately 5 to 8 miles west of Mount Jefferson, in Linn County, Oregon (see Figure 16-1). Lease boundaries could be adjusted in the decision to avoid unacceptable impacts on sensitive resources.

One pending lease application is included within this area, which is identified on the 1982 Geothermal Resources of Oregon map as being an area likely to be used for direct use heat applications (National Oceanic and Atmospheric Administration 1982). The single pending lease application is OROR 054587, which is comprised of 1,115.280 acres comprised of three non-contiguous sections of land. The legal description of this land is (1) T10S R7E S29, parts NE, NESE; (2) T11S R7E S2, parts S2NE, SENW, E2SW, "SE outside wilderness," Lots 1-3; (3) T11S R7E S3, parts S2NW, S2, Lots 3, 4.

Section 2 contains one forked, unnamed logging road, providing access to some logged areas. Highway 22 (North Santiam Highway) passes through Section 3 and provides access to Riverside Campground. NFD 2242 Road runs through Section 29.



The lease site is on NFS lands. The North Santium River runs generally alongside Highway 22.

LEGEND:

Lease site boundary

Willamette Lease Location

OROR 054587

Willamette NF / Salem District

Figure 16-1

The lease sites range in elevation from 2,200 feet to 4,400 feet above mean sea level. The lease area is largely covered by forest, with substantial portions of Section 2 and smaller portions of sections 3 and 29 having been clearcut. No other developed uses or buildings have been identified within one mile of the lease sites.

16.2.3 ALTERNATIVES

Two alternatives are considered in this lease-specific analysis: Alternative A, the No Action alternative, and Alternative B, Leasing with Stipulations.

Alternative A: No Action

Under Alternative A, the FS would not issue a consent determination and the BLM would not issue the pending lease application.

Alternative B: Leasing with Stipulations

Under Alternative B, the FS would provide a consent determination for the lease application, and the BLM would issue the lease with the stipulations identified in Chapter 2 of the PEIS.

16.2.4 REASONABLY FORESEEABLE DEVELOPMENT SCENARIO

The pending noncompetitive lease application was filed by the Estate of Max R Millis in 1974 and is expected to be developed for electricity generation. The site is expected to be developed by two powerplants; one 30 megawatt plant in the western half of Section 2 (the eastern half of this section is within an Inventoried Roadless Area), and one 20 megawatt plant in Section 29. It is expected that a 30 megawatt plant would result in 15 acres of land disturbance, and a 20 megawatt plant would result in 10 acres of land disturbance, for a total disturbance of 25 acres. Existing Forest Service roads would be used to access the sites.

Exploration activities for a 20 megawatt plant and a 30 megawatt plant is expected to involve approximately 12 temperature gradient holes, disturbing approximately 0.15 acre each, for a total disturbance of approximately 2 acres. Disturbance would result from the types of activities described under Chapter 2 of the PEIS under *Phase One: Geothermal Resource Exploration*.

Assuming that a commercially viable resource is found within both portions of the lease area identified as being suitable, drilling operations and development of the site would be expected to result in a further approximately 8 acres of land disturbance (roughly 5 acres for the 30 megawatt plant and 3 acres for the 20 megawatt plant) from the types of activities described in the Reasonably Foreseeable Development scenario of Chapter 2 of the PEIS under *Phase Two: Drilling Operations*.

Utilization, the third phase of a geothermal project, is expected to result in a further approximately 15 acres of land disturbance (roughly 9 acres for the 30 megawatt plant, and 6 acres for the 20 megawatt plant) from the types of activities described in the Reasonably Foreseeable Development scenario of Chapter 2 of the PEIS under *Phase Three: Utilization*. The length and alignment of transmission lines are not estimated here since these factors would depend upon the positioning of any power plant and the distance to the nearest electrical tie-in.

Reclamation and abandonment, the fourth phase of a geothermal project, is expected to result in temporary disturbance of all originally disturbed acres, after which, the site would graded and vegetated to pre-disturbance conditions, as described in the Reasonably Foreseeable Development scenario of Chapter 2 of the PEIS under *Phase Four: Reclamation and Abandonment*.

SECTION 16.3
AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

16.3.1 INTRODUCTION AND GEOGRAPHIC SETTING

The following resource disciplines are not addressed in this section because they are not found in the leasing areas and are not relevant to the discussion: livestock grazing, historic or scenic trails, wild horse and burros, special designations.

All the pending lease applications are in geologic units that would be expected to have a relatively low potential for containing vertebrate fossils or scientifically significant invertebrate or plant fossils; therefore, paleontological resources are not analyzed in detail. Paleontological mitigative procedures outline in the PEIS would be followed for all ground distributing activities. Protective measures outlined in the PEIS would be applied.

Future development of the proposed lease sites would also yield the same health and safety impacts as identified in Chapter 4 of Volume I of the PEIS and therefore is not repeated in this lease-specific analysis.

16.3.2 LAND USE, RECREATION AND SPECIAL DESIGNATIONS

Setting

This section is a discussion of the current land ownership and use within the Region of Influence for the three lease sites that are part of the proposed action. The Region of Influence is the land area within and adjacent to the potential lease sites.

Policies and Plans

It is the policy of the Department of the Interior, consistent with Section 2 of the MMPA and Sections 102(a) (7), (8) and (12) of FLPMA, to encourage the development of mineral resources, including geothermal resources, on federal lands. The Geothermal Steam Act of 1970 provides regulatory guidance for geothermal leasing by the BLM. Additional guidelines for geothermal leasing are provided in area Forest Service and Land Management Plans. Once revised, the

Willamette Forest Plan and the Salem RMP will be tiered to the Northwest Forest Plan. Details of the current plans in relation to geothermal leasing are included in Section 16.1.

Regional Setting

The lease area is located in a river valley centered on the North Santiam River in Linn County, Oregon. The total lease area covers approximately 1,115 acres in three non-contiguous sections west of Mt. Jefferson. Lands within and adjacent to potential lease sites are all NFS lands. NFS lands are administered for multiple uses, including some which may be incompatible with energy development.

The nearest population centers are Detroit, approximately 10 miles from the lease sites and Mill City, approximately 25 miles from the lease sites.

In addition to the existing Riverside campground and trail, dispersed recreation occurs throughout the proposed lease area. Some popular recreational activities with the Willamette National Forest and Salem BLM District include hiking, camping, fishing, hunting, off-highway vehicle use, and Nordic skiing (US Forest Service 2006).

Lease Areas

According to the Northwest Forest Plan, all three of the areas are in a designated Late-Successional Reserve and a Key Watershed, areas of sections 2 and 29 that are within the 100-year floodplain of the North Santiam River are within Riparian Reserves, and portions of the lease sites are also contained within management areas with special designations for wildlife protection under the Forest Plan.

The North Santiam River has been determined to be eligible for inclusion into the National Wild and Scenic River System as a Section 5(d) river (Forest Plan) in the Wild and Scenic Rivers Act. Until suitability has been determined, the river shall be managed within a quarter mile of each side to meet Standards and Guidelines prescribed for Wild and Scenic River Management Area 6c. Activities shall not preclude the river from potential inclusion into the National Wild and Scenic Rivers System. This designation would preclude any geothermal activity in sections 3 and 29.

Chapter 1 of this analysis discusses the standards and guidelines set forth in the NWFP related to geothermal development in Riparian Reserves. NWFP guidance on Late-Successional Reserves does not address geothermal development. NWFP guidance on Key Watersheds includes a description of an Aquatic Conservation Strategy. The applicable portions of this strategy are:

- Reduce existing system and nonsystem road mileage outside roadless areas. If funding is insufficient to implement reductions, there will be no net increase in the amount of roads in Key Watersheds.

- Key Watersheds are highest priority for watershed restoration.
- Watershed analysis is required prior to management activities, except minor activities such as those Categorically Excluded under NEPA (and not including timber harvest).
- Timber harvest cannot occur in Key Watersheds prior to completing a watershed analysis.

Details for these designations are provided in Section 16.3.9, *Fish and Wildlife*.

Section 29
This lease area contains NFD road 2242, which runs north to south in the western portion of the lease site, and the North Santiam River, which winds in a north-south orientation through the center of the site. No other development exists in the area and land use is primarily limited to forestry and recreational use. Nearly all of the Section 29 portion of the lease site is within a quarter mile of the Santiam River, and is therefore required to be managed under the Wild and Scenic River management guidelines discussed above.

Section 2
This lease site contains a forked logging road and Forest Service trail number 3448 is found in this lease area. Mt. Jefferson wilderness area lies adjacent to the SE boundary of the lease area. This wilderness area contains 190 miles of trails and is a popular destination for hiking and back-country camping (US Forest Service 2006). The eastern half of this lease site is contained within an Inventoried Roadless Area. No other development exists in the area and land use is primarily limited to forestry and recreational use.

Section 3
The North Santiam River runs north to south in the southeastern and north portions of the site. Highway 22 lines the river on the east, crossing through the southeastern and north sections of the site. The Riverside campground is found in the SW portion of the site, between the highway and the river. No other development exists in the area and land use is primarily limited to forestry and recreational use. All of the Section 3 portion of the lease site is within a quarter mile of the Santiam River, and is therefore required to be managed under the Wild and Scenic River management guidelines discussed above.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on existing land uses, including existing recreational uses and would not conflict with the Salem District RMP, the Northwest Forest Plan or the Forest Plan.

Alternative B (Proposed Action)

The Proposed Action would not cause any direct impacts on land use or recreation; however, the anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. According to the Reasonably Foreseeable Development scenario, two plants are likely to be developed at the lease site; one plant in the western portion of Section 2 resulting in 15 acres of land disturbance, and another in Section 29 with 10 acres of land disturbance. Access to the plant sites would be provided via existing FS roads and should not disturb additional acres.

Geothermal activities could impact all dispersed recreational uses within the lease sites. Through noise, visual impacts of facilities, deforestation, and interruption of previously accessible areas, the quality of dispersed recreational uses would likely decrease.

Anticipated geothermal exploration and development activities likely to follow leasing have the potential to conflict with management guidelines and standards set forth by the Northwest Forest Plan and the Willamette Forest Plan for those areas contained within Late Successional Reserves, Riparian Reserves, Key Watersheds, Wild and Scenic Rivers, and within management areas with special designations for wildlife protection under the Forest Plan.

Impacts on Riparian Reserves

Per the discussion of the Northwest Forest Plan in Chapter 1, no new geothermal development is permitted in Riparian Reserves where leases do not already exist. On federal lands, riparian reserves are designated to protect water quality. The reserve's width is based on the presence of fish and whether the stream is permanent or intermittent (see Table 16.3-1 below). Riparian reserve widths are determined by the average maximum height of the tallest trees in the area, "site-potential tree height", or a minimum width requirement. Any development within the Riparian Reserve would have the potential to conflict with the Northwest Forest Plan and the Willamette Forest Plan. The issuance of pending noncompetitive lease applications would not conflict with the NWFP with respect to Riparian Reserves if lease stipulations state that no surface disturbing activities are to occur within the designated riparian buffer zones based on the above criteria.

Impacts on Key Watershed

In the Upper North Santiam Watershed, as of 2005 the "tally" for the watershed was (-4.39) miles of road. During the life of the NWFP, 0.41 mile of road has been constructed and 4.8 miles have been decommissioned. Anticipated geothermal exploration and development activities likely to follow leasing would not conflict with the NWFP in terms of Key Watersheds if lease stipulations state that no new roads shall be constructed that would result in a net increase in roads within the watershed over the initial benchmark.

Table 16.3-1
Federal Riparian Reserve Width Requirements
(Each side of the Stream)

Stream Class	Riparian Reserve Width
Fish Bearing	Average height of 2 site potential trees or 300-344 feet
Permanent Non-Fish Bearing	Average height of 1 site potential tree or 150-172 feet
Intermittent	Average height of 1 site potential tree or 100 feet

Impacts on Late-Successional Reserves

Anticipated geothermal exploration and development activities likely to follow leasing have the potential to impact old growth forests in Late-Successional Reserves. The Standards and Guidelines in the NWFP for Late-Successional Reserves require that the Willamette NF assess the impacts of proposed mining actions, and that the NF include in mineral activity permits appropriate stipulations (e.g., seasonal or other restrictions) related to all phases of mineral activity. The guiding principle is to design mitigation measures that minimize detrimental effects to late-successional habitat. These mitigation measures would reduce impacts on Late-Successional Reserves.

Impacts on Inventoried Roadless Areas

The status of pending lease land as Inventoried Roadless Areas would limit geothermal development the eastern half of Section 2. Development in this area would be consistent with the Inventoried Roadless Area designation as long as no new roads are constructed to access development sites. Since there are no existing roads in or adjacent to the roadless area, no surface occupancy could take place here. There would be no impact in Inventoried Roadless Areas.

Impacts on Wild and Scenic Rivers

No geothermal development would be allowed in sections 3 or 29; therefore, there would be no impacts on the "free-flowing character" or "Outstandingly Remarkable Values" of the North Santiam River.

Potential conflicts with other wildlife management areas are discussed further in Section 16.3.9, *Fish and Wildlife*.

16.3.3 Geologic Resources and Seismicity

Setting

The pending lease sites lie within the Pacific Mountain System portion of the Pacific geological province, which extends from southern California through the Kenai Fjords of Alaska. The Pacific province is one of the most geologically young and tectonically active regions in North America. The region straddles the boundaries between several tectonic plates, including the Juan de Fuca, and North American Plate. Where the Juan de Fuca Plate converges with the North America plate the Cascade subduction zone occurs as the heavier oceanic plates slide underneath the buoyant North American plate. There are some unusual features in the Cascade subduction zone. Where the Juan de Fuca plate sinks beneath the more buoyant North American Plate there is no deep trench, lower seismic activity than expected, and there is evidence of a decline in volcanic activity over the past few million years. The probable explanation lies in a present slower rate of convergence (three to four centimeters per year) (US Geological Survey 2004).

As subduction occurs, high temperatures and pressures allow water molecules locked in minerals of solid rock to escape. The water vapor rises into the pliable mantle above the subducting plate, causing some of the mantle to melt. This newly formed magma rises toward the Earth's surface to erupt, forming a change of volcanoes, known as the Cascade Range, above the subduction zone. The Cascade Range extends from British Columbia to Northern California, roughly parallel to the coastline. Within this region 13 major volcanic centers line in sequence. Initially formed 36 million years ago, the range's major peaks date to the Pleistocene. The majority of the Cascades consist of small, short-lived volcanoes built on a platform of lava and volcanic debris. Rising above this platform a few large volcanoes, dominate the landscape (US Geological Survey 2004).

All the lease sites lie within approximately nine miles of Mt. Jefferson, a stratovolcano composed of andesite and dacite. The formation of Mt. Jefferson occurred in two episodes. The earlier episode constructed a volcano that was likely higher than the present day mountain. Glaciers carved deep canyons into this volcano and deposited sediments across the fertile floor of the Willamette Valley, which extends west of the Cascades. This episode ended with the growth of dacite domes near the summit and collapse of the dome to produce ash flows. The more recent episode of volcanism likely occurred when glaciers were present on Mt. Jefferson, as the lava flow is distributed in an unusual stacked pattern, possibly the result of containment to steep glacier valley (University of North Dakota 2000).

According to a 1999 US Geological Survey report, valleys heading on Mt. Jefferson that lie within the lease area are subject to lahars (mudflows of pyroclastic material and water) with volumes of 20 million cubic meters at the highest probability. The area also subject to debris avalanches as the result of heavy rain on loose soils (US Geological Survey 1999).

Impacts

Alternative A (No Action)

The No Action alternative would have no direct impact on geological resources, and would not put any people or structures at risk from seismic-related events.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impacts on geological resources or put people or structures at risk from seismic events; however, anticipated actions following leasing could have impacts on these resources and result in risks related to seismicity through inducing seismic events from injection into the geothermal reservoir, increased human presence on the site, and construction of facilities, infrastructure and transmission lines.

Prior to construction of any facilities or infrastructure, geotechnical investigations would need to be conducted to ensure that any construction can withstand strong seismic events, and that facilities would be placed within safe distances from potential lahar and debris-slide areas.

16.3.4 Energy and Minerals

Setting

The electric utility provider for the region of the lease area is Portland General Electric in coordination with local electric cooperatives. Portland General Electric is Oregon's largest utility and serves over 4,000 square miles and 52 cities in Oregon. Portland General Electric manages company-owned power plants and purchases power supplies on the wholesale market. Their mix of generating resources includes hydropower, coal and gas combustion, and wind. Their 12 power plants have a total combined generating capacity of 1,974 megawatts (Portland General Electric 2006).

Renewable energy is promoted at Portland General Electric through the "Green Power Oregon" program, which allows consumers to purchase wind or biomass off-sets of residential or business use for a supplemental cost (Portland General Electric 2006).

The Oregon Renewable Portfolio Standard Program is an Oregon law that requires the largest utilities in Oregon to provide 25 percent of their retail sales of electricity from clean, renewable sources of energy in 2025. Smaller utilities will have similar, but lesser, obligations. Geothermal energy is included in the definition of renewable resources under the program.

No mineral extraction sites are located within the lease sites. Gold and silver deposits have been found in a 25-30 mile wide, north-south belt in the Western Cascades of Oregon. In the vicinity of the lease area, 2 major mineral mining districts have been identified; the North Santiam district in Marion and Clackamas counties and the quartzville district in Linn County on the Middle Fork of the Santiam River (US Forest Service 1990). The North Santiam District was active primarily in the 1920s to 1930s with copper, zinc, and lead being the primary metals extracted (Callaghan and Buddington 1938).

The region is generally not considered to have high potential for oil and gas leasing. In the 1970s an increased interest in the areas resulted in 200,000 leases, but most of these have now been withdrawn (US Forest Service 1990). Within the Salem District, the only developed oil or gases are is at Mist Gas Field, far from the lease area (Bureau of Land Management 2007).

In the Forest as a whole there has been considerable interest in geothermal development; over 55 exploratory temperature gradient holes were drilled in the early 1980's. In addition, three hot springs within the Willamette NF at Breitenbush, Belknap-Foley, and McCredie–Kitson had been identified as having high geothermal resource potential by the US Geological Survey (US Forest Service 1990).

Impacts

Alternative A (No Action)

The No Action alternative would have no direct impact on energy and mineral resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on energy or mineral resources; however, anticipated future actions following leasing would potentially result in such impacts. Based on the Reasonably Foreseeable Development scenario, the site is expected to be developed by one 30 megawatt plant in Section 2, and one 20 megawatt plant in Section 29. Details of impacts on energy and minerals are discussed for a standard 50 megawatt plant in Section 4 of the PEIS. Similar impacts are anticipated at the lease site. This impact would allow existing geothermal resources in the area to be utilized, and would contribute a renewable source of energy to the local and regional power grid. The Proposed Action could potentially contribute to State efforts to meet the RPS as discussed in Section 16.1 of this analysis.

16.3.5 Soils

Setting

This lease site is dominated by soils of alluvial, colluvial, volcanic, and glacial origin. Soil types are a combination of flat lying alluvial floodplains, gently sloping alluvial terraces, moderate to steep sloping (40 to 80% slope) soils of glacial origin on various bedrock types, and steep (50 to 90% slope), rocky, colluvial derived soils with depths of one to eight feet on volcanic tufts, breccias, and basaltic and andesitic bedrock mixed with glacial soils. A small area of older, stabilized slump/earthflow terrain is found in Section 29 (Shank 2008).

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on soils.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on soils; however, anticipated future actions following leasing would potentially result in impacts on erosion and compaction associated with ground disturbance from the geothermal exploration and development process.

Prior to construction of any facilities or infrastructure, geotechnical investigations would need to be conducted to ensure that any construction be situated on stable soils, and that erosion-prevention measures be implemented in accordance with permitting requirements.

16.3.6 WATER RESOURCES

Setting

Surface Water

The North Santiam River traverses sections 3 and 29. All three sections contain unnamed streams: four in Section 2, one in Section 3, and two in Section 29. Section two contains a coldwater spring, and Section 3 contains the Riverside Campground.

The major surface water features in the lease site is the North Santiam River. At Detroit Dam, this river has a flow rate ranging from an average of 434 cubic feet per second in September, to 1,400 in May (US Geological Survey 2008a). The river flows to the north through the lease area, then turns west through Detroit Lake, Mehama, and on to Salem. The City of Salem water-treatment facility withdraws water from the North Santiam River.

The project area is within the North Santiam subbasin of the North Santiam River Basin, within the Willamette Valley. In 1998, a monitoring program was initiated to better understand the sources and transport of sediment that causes high turbidity within the North Santiam River Basin. The project is a cooperative effort of the City of Salem, the U.S. Geological Survey (USGS), the U.S. Forest Service, and the U.S. Army Corps of Engineers. The nearest water quality monitoring station to the lease area is near Detroit, and monitoring there began in October 1998 (US Geological Survey 2008b).

Turbidity is a major water quality concern in the North Santiam River, which becomes exacerbated during heavy rain events and flood conditions as soils are transported into the river system (US Geological Survey 2008b). No other water quality concerns are reported for the North Santiam River in the lease area.

A Total Maximum Daily Load (TMDL) for the Willamette Basin was approved by the US Environmental Protection Agency on September 29, 2006. The North Santiam subbasin has stream segments listed under Section 303(d) of the federal

Clean Water Act that are exceeding water quality criteria for temperature and dissolved oxygen (Oregon Department of Environmental Quality 2008). Temperature is a greater concern than turbidity in the North Santiam River (Halemeier 2008).

Ground Water

The lease site is located to the east of the Willamette River Valley portion of the Puget-Willamette Trough regional aquifer system, an extensive system of aquifers and confining units that may locally be discontinuous but function hydrologically as a single aquifer system on a regional scale. The Trough extends southward from near the Canadian border to central Oregon (US Geological Survey 1994).

The principal aquifers that compose the Willamette River Valley are unconsolidated-deposit and Miocene basaltic rock aquifers of a thickness of approximately 200 feet near Salem, which thin rapidly southward and toward the margins of the valley; these deposits are generally less that 100 feet thick. Miocene basaltic-rock aquifers consist primarily of thick basaltic lava flows that were extruded from major fissures. Some of the open spaces initially formed during cooling or subsequently formed during folding have been filled with secondary clay minerals, calcite, silica, or unconsolidated alluvial deposits emplaced by streams or in lakes. Except where such fill materials are coarse grained, these secondary deposits tend to markedly decrease the permeability of Miocene basaltic-rock aquifers (US Geological Survey 1994).

Miocene basaltic rock aquifer permeability is extremely variable. Maximum specific-capacity values are approximately 3,000 gallons per minute per foot of drawdown. Some interbeds of unconsolidated deposits that contain water under unconfined and confined conditions can yield as much as 100 gallons per minute (US Geological Survey 1994).

The section of the aquifer in and around the lease sites is in undifferentiated volcanic and sedimentary rocks from the Pliocene era and younger, including beds of volcanic ash and tuff, silicic volcanic rocks, and semiconsolidated to consolidated sedimentary rock that contain small to large quantities of volcanic material. These rocks are complexly interbedded, and their permeability is extremely variable. The permeability of the various rocks that compose the aquifers is extremely variable. Interflow zones and faults in basaltic lava flows; fractures in tuffaceous, welded silicic volcanic rocks; and interstices in coarse ash, sand, and gravel mostly yield less than 100 gallons per minute of water to wells. Interbedded almost impermeable rocks may retard the downward movement of groundwater and create perched water table conditions in some areas (US Geological Survey 1994).

Discharge from the aquifer occurs via evapotranspiration, leakage to adjacent aquifers, withdrawals from wells, movement of water to surface-water bodies, and discharge from springs. Groundwater levels are highest in the spring as a result of recharge from snowmelt, and decline through summer when evapotranspiration rate cause discharge to exceed recharge. Ground water quality is generally fresh and chemically suitable for most uses; sparse settlement in the area has prevented much groundwater contamination. Public, domestic and commercial, agricultural, and industrial uses are the main uses of ground water in this area (US Geological Survey 1994).

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on water resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on water resources; however, anticipated future actions would potentially result in such impacts, as described below.

Water Quality

Typical impacts on the quality of surface water and ground water from geothermal development are described in Chapter 4 of the PEIS under Water Resources. Geothermal waters could introduce contaminants into the drinking water aquifer. Subsequent project-specific environmental reviews and permits would ensure that drilling procedures, including the installation of well casings and sealings, are conducted to current Oregon well construction standards. Lease stipulations and best management practices addressing stormwater are included in Chapter 2 and Appendix D, respectively, of the PEIS and would reduce impacts on water quality.

A watershed analysis would not be required because the watershed analysis for this watershed has been completed and was revised/updated in 2007. Since anticipated future actions following leasing would not result in impacts that have the potential to have impacts at the watershed scale, there would not be any need to do any further revision or updating. The watershed analysis and recent update should be sufficient to provide information necessary for from the watershed scale for the individual geothermal activities described in the Reasonably Foreseeable Development scenario.

Water Quantity

Indirect use geothermal projects require large amounts of water during all phases of a project from exploration through reclamation and abandonment; therefore, the anticipated future actions following leasing could result in impacts on the surface water and ground water quantities. Both groundwater and surface waters are abundant in the lease area, and no impacts on existing water resources are expected.

Section 2 contains a surface spring, which could be affected by any drawdown of the local water table. The potential for impacts on springs depends upon the proximity of the pumping, the hydraulic characteristics of the aquifer, and the magnitude and duration of pumping. Due to the abundance of groundwater in the area and few to no competing groundwater users, impacts on this spring are not expected; however, lease stipulations should include a requirement to maintain a buffer from this spring to protect its flow rate and its attractiveness to both wildlife and recreationalists.

Water needs of a powerplant could alternatively be sourced from the North Santiam River. Water rights would have to be applied for from the Oregon Water Resources Department by the project proponent. This permitting process would determine whether the proposed usage of the river's waters would be in line with the river's beneficial uses.

16.3.7 AIR QUALITY AND ATMOSPHERIC VALUES

Setting

The lease area is located in Linn County, an area with unclassified air quality standards. Due to the remote location of the lease sites, air quality is considered to be good.

The lease site is within the Willamette Valley, on the western foothills of Mount Jefferson, which is part of the Cascade Mountains. Air masses from the west are forced to ascend causing them to give up moisture, resulting in high levels of precipitation in the area. Climate in the Willamette Valley is relatively free of extremes in temperatures, with abundant rainfall most of the year.

The closest weather monitoring station to the lease site is at Detroit Dam, Oregon, approximately 10 miles northwest of the lease area. Average maximum temperatures at Detroit Dam range from 43.3 degrees Fahrenheit in January, to 79.0 in August, with average minimum temperatures ranging from 33.2 degrees Fahrenheit in January, to 53.7 in August (Western Regional Climate Center 2007).

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on air quality or atmospheric values.

Alternative B (Proposed Action)

The Proposed Action alternative would not have any direct impacts on air quality or atmospheric values; however, anticipated future actions following leasing could result in such impacts. Future actions following leasing would not result in violations of ambient air quality standards given the unclassified status of the county and the good level of air quality. The nature of impacts on air quality and atmospheric values are discussed in Section 4.8 of this PEIS.

16.3.8 VEGETATION

Setting

The pending lease area located within the western hemlock (*Tsuga heterophylla*) zone of the Northern Cascades Physiographic Province (Franklin and Dyrness, 1988). Mt. Jefferson (elevation 10,497 feet above mean sea level) rises up from the lease area on the east side. There are three portions of the lease site. Two straddle the North Santiam River (sections 3 and 29), while one area (Section 2) is on an upload slope on the east side of the river.

Events of both natural and human origin have modified forest stands in the lease area. Natural disturbance events include wind and snow storms, wildfire, and floods. Human disturbance of vegetation has occurred through timber management activities, fire, and recreational use. The lease area is a mosaic of forest stand ages, containing both old-growth and second growth coniferous forest. The area is federally managed as National Forest System lands, and timber harvest is currently restricted as the entire area is part of the Jefferson Late-Successional Reserve. The forest types include coniferous and mixed riparian forests.

Late-Successional Reserves

In 1994 the Northwest Forest Plan (NWFP) designated a network of Late-Successional Reserves (LSR) with the object of protecting and enhancing conditions of late-successional and old-growth forest ecosystems, and the species that depend on this habitat (US Forest Service 1994). Timber harvest and other development activities are limited in LSRs. All three of the proposed lease sites are within the Jefferson LSR.

Coniferous and Mixed Coniferous/Deciduous Forest

Coniferous forests capable of exhibiting great biomass and longevity dominate the lease area (US Forest Service, 2008a). Old-growth coniferous forests are characterized by very old and large overstory trees. Old growth forests have multiple structural attributes that make them high value areas for wildlife, including variation in tree size and spacing, broken and deformed tops, multiple canopy layers, canopy openings, variation and patchiness of understory composition, and large-diameter standing dead and downed trees. This complex habitat supports a large number of plant and animal species, some of which are found only in late seral forests. Mature forests typically exhibit some, but not all, of the components of old-growth forests. These forests make up much of the areas proposed for leasing.

Deciduous Forest and Shrub Habitats

Deciduous forest stands in the vicinity are found in sites with relatively recent ground disturbance, such as timber harvest and riparian zones along North Santiam River. Red alder *Alnus rubra*) is the dominant species of disturbed soils within the western hemlock zone; it is also common within riparian zones. Big-leaf maple (*Acer macrophyllum*) is common in riparian zones and in openings in coniferous forest. Deciduous shrub communities may persist along the riparian corridors, these are typically dominated by willows (*Salix species*) and vine maple (*Acer circinatum*) (Franklin and Dyrness 1988). Deciduous forest stands along riparian zones can provide locally unique wildlife habitat when certain structural features are present. Locally unique features can include variation and patchiness of understory vegetation, snags and downed logs, seasonal canopy cover, and stream shading.

Riparian Habitats and Wetlands

Riparian habitats are located at the interface between terrestrial habitats and aquatic environments. Deciduous forest and shrub habitats are characteristic along active channels of low gradient waterways with well-developed floodplains. Riparian zones narrow with increasing stream gradient on the north and west sides of the lease area, leading to stands of mixed coniferous and deciduous species. Along narrow higher gradient streams, as are most common in the lease area, coniferous tree species dominate the overstory. On Forest Service lands in the lease area, an estimated 10 percent of the riparian area has been disturbed by timber harvest.

Wetlands in the vicinity of the lease area include forested, scrub, emergent, and open water habitats of small ponds, however, there are no documented wetlands within the lease area itself (US Fish and Wildlife Service 2008). The most common tree species associated with forested wetlands are red alder, black cottonwood, and western redcedar. Shrub wetlands in the basin are characterized by various willow species, salmonberry, vine maple, and spiraea (*Spiraea douglasii*). Freshwater forested scrub wetlands exist along the North Santiam River in several locations, including within the lease sites straddling the river. These wetlands support a variety of sedges, forbs, and grasses (US Fish and Wildlife Service 2008). Wetlands provide valuable plant, fish, and wildlife habitat, and are also valued for their hydrologic functions. The Forest Service manages the land adjacent to streams, lakes, reservoirs, and wetlands as Riparian Reserves, per the direction of the Northwest Forest Plan (US Forest Service 1994).

Riparian Reserves

On federal lands, riparian reserves are designated to protect water quality; timber harvest is prohibited and ground disturbance is not allowed. Under the Northwest Forest Plan riparian reserve areas are associated with flowing streams, as well as intermittent and ephemeral streams. The guidance given under the NWFP is to designate riparian reserves if an areas or feature shows annual scour or deposition. The width of a riparian reserve is based on the presence of fish and whether the stream is permanent or intermittent, and by the average maximum height of the tallest trees in the area or a minimum width requirement. The riparian reserve that borders the North Santiam River is 344 feet on either side of the river's ordinary high water mark (Halemeier 2008).

Invasive and Non-Native Plant Species

Invasive and non-native plant species are known to occur in the lease area and vicinity. These species can be aggressive, out-competing native plant species, reducing the value of wildlife habitat, and affecting waterways and aquatic habitats. Management goals for noxious weed species may range from complete eradication to containment of the species within a currently infested area. Multiple invasive plant species are documented along the Highway 22 corridor and are expected to occur in the lease sites. Potential species include tansy ragwort, St. John's-wort, and Scotch Broom (US Forest Service 2007).

Impacts

Potential impacts on vegetation and important habitats could occur if reasonably foreseeable future actions were to:

- Affect a plant species, habitat, or natural community recognized for ecological, scientific, recreational, or commercial importance;
- Affect a species, habitat, or natural community that is specifically recognized as biologically significant in local, state, or federal policies, statutes or regulations;
- Establish or increase noxious weed populations;
- Destroy or extensively alter habitats or vegetation communities in such a way that would render them unfavorable to native species; or
- Conflict with FS management strategies.

Alternative A (No Action)

The No Action alternative would have no impact on vegetation and important habitats.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on vegetation; however, anticipated future actions following leasing would potentially result in impacts on vegetation through an estimated disturbance of approximately 25 acres. Potential impacts associated with future exploration, drilling operations and development, utilization, and reclamation and abandonment would include:

- Habitat disturbance – Site clearing, well drilling, construction of access roads and geothermal facilities, as well as maintenance and operational activities would disturb timber and scrub habitat, increase risk of invasive species, and alter water and seed dispersion, as well as wildlife use, which can further affect vegetation communities.

- Direct Removal and Injury – Trees and other vegetation would be cleared for roadways, vehicle staging, buildings, pipelines, and transmission lines. Activities could result in loss of soil, loss of seed bank in soil, deposition of dust and. Maintenance around project components, such as drill pads, buildings, pipelines, or other facilities would involve mowing, herbicide treatment, and other mechanical or chemical means of removal and control. This would result in a net loss of important habitats and communities in the lease area.
- Invasive Vegetation – Disturbance and access by vehicles and human foot traffic may expose areas to colonization by invasive and non-native species, making it more difficult for endemic species to reestablish in disturbed areas and threatening the continued existence of endemic species (Bureau of Land Management 2007).
- Fire – Increased vehicular and human traffic, operation of equipment, the use of drilling muds, and the extraction of geothermal fluids can increase the risk of fires. Vehicles, electrical lines, and cigarette smoking can all result in accidental fires. Fires destroy valuable timber and forest vegetation, and can aid in the establishment of invasive species.
- Erosion – Site clearing, grading, construction of access roads, containment basins, site runoff and vehicle and human foot traffic cause erosion. The effects of erosion include the removal of top soil, loss of seed bank, loss of native vegetation, the establishment of invasive species, the sedimentation of streams, and flooding (which can directly result in affects to riparian vegetation and riparian habitats).
- Exposure to Contaminant – Vehicle fuel, hydraulic fluid, solvents, cleaners, and geothermal fluids can all be harmful to vegetation and important habitats, such as riparian areas. Accidental spills can contaminate soils and water and directly harm vegetation. Licensed herbicide use would likely be used to control vegetation around geothermal facilities and support structures. Spills of herbicides or acute exposure to herbicides can have adverse affects on non-target vegetation.

Old Growth and Late Successional Reserves

Old growth forests, including Late-Successional Reserves, are present throughout much of the lease area. These forests are protected under the provisions of the Northwest Forest Plan (US Forest Service1994); these protections are expected to remain in place in the future. Geothermal development of the lease sites would result in the removal of forest, and may include old-growth and late-successional reserves. Specific impacts affecting old-growth forest are discussed further in the PEIS, Section 4.9 Vegetation and Important Habitats.

Riparian and Wetland Habitats

Riparian habitats are found along North Santiam River and Grizzly Creek, as well as throughout the forest as riparian swells, drainages, and intermittent unnamed streams. These habitats are protected as part of the Northwest Forest Plan and would be protected through best management practices if the lease sites were developed. Development is not allowed within riparian reserves. However, potential impacts on riparian habitats would still exist. They would include sedimentation, runoff, erosion, and effects to water quality and hydrology. Refer to section 4.9 of the PEIS for a more detailed discussion of the potential impacts on riparian habitats resulting from each stage of a geothermal project.

Wetland habitats have been documented within both lease sites straddling the North Santiam River. However, conditions are dynamic and may change over time. Wetland delineations would be conducted prior to activities that may disturb wetlands as the result of geothermal activities at the pending lease sites. Impacts that could occur to wetlands include dewatering, changes in hydrology, disturbance, and removal. Impacts on wetlands are regulated under the River and Harbors Act and Section 404 of the Clean Water Act. Permitting from the U.S. Army Corps of Engineers (Corp) will be required if future development at the site will have any impact on wetlands under Corps' jurisdiction. In addition, EO 11990, "Protection of Wetlands," requires all federal agencies to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. A more complete discussion of the potential impacts on wetlands resulting from geothermal activities is can be found in Section 4.9 of the PEIS.

16.3.9 FISH AND WILDLIFE

Setting

Fisheries

The following section describes the existing aquatic habitat and fish species occurring in North Santiam River and Grizzly Creek, which is a tributary to the North Santiam River and runs just north of Section 2. The proposed lease sections 3 and 29 straddle the North Santiam River. The two waterways provide habitat for Chinook salmon (*Oncorhynchus tshawytscha*), rainbow trout (*O. mykiss*), cutthroat trout (*O. clarki*), naturalized sockeye salmon (commonly referred to as kokanee salmon (*O. nerka*)), long-nosed (*Rhinichthys cataractae*) and black sided dace (*Phoxinus cumberlandensis*), and sculpins (US Forest Service 2007).

Anadromous Fish Species

Resident and hatchery fish Spring Chinook salmon and steelhead historically utilized North Santiam River. Access to this habitat was eliminated in 1953 with the construction of Detroit dam, which does not provide upstream passage. Spring Chinook salmon, of hatchery origin, have been reintroduced above the dam, starting in the year 2000. These fish are released in the North Santiam River and area expected in the lease area. Steelhead have not been transported and released above Big Cliff Dam (US Forest Service 2007).

The National Marine Fisheries Service (NMFS) recently completed their final listing determinations for 16 evolutionarily significant units (ESUs) of West Coast Salmon (70 FR 37160; effective August 29, 2005). They listed the Upper Willamette River Chinook salmon ESU as threatened under the Endangered Species Act, confirming their earlier determination (64 FR 14308; effective May 24, 1999). This includes Chinook in the Santiam River. The NMFS has designated critical habitat for 12 ESUs of West Coast Salmon and Steelhead in Washington, Oregon, and Idaho (70 FR 52630; effective January 2, 2006). Designated critical habitat for Chinook salmon does not extend above Big Cliff dam, and would not be affected by activities in the lease area (US Forest Service 2007).

Similarly, the Magnuson-Stevens Fishery Conservation and Management Act lead to the designation of Essential Fish Habitat (EFH) for commercially harvested fish, which includes Chinook salmon on the Willamette National Forest. Their designation of EFH did not include any streams above Big Cliff dam, and therefore EFH would not be affected by geothermal activities occurring in the lease area.

Wildlife

This section describes the occurrence and distribution of wildlife species in the lease area and vicinity.

Reptiles and Amphibians

Reptiles likely to inhabit the area include the western terrestrial garter snake (*Thamnophis elegans*), common garter snake (*Thamnophis sirtalis*), and northern alligator lizard (*Elgaria coerulea*). Amphibians potentially present in the wetland and riparian habitat occurring in the lease sites include Pacific giant salamander (*Dicamptodon tenebrosus*), northwestern salamander (*Ambystoma gracile*), long-toed salamander (*Ambystoma macrodactylum*), northern rough-skinned newt (*Taricha granulosa*), Pacific chorus frog (*Pseudacris regilla*), northern red-legged frog, and the non-native bullfrog (*Rana catesbeiana*).

Birds

Forested habitats in the lease area may contain game birds, raptors, songbirds, and other birds. Bird species closely associated with old-growth and late successional forests found in the lease area includes the northern spotted owl (*Strix occidentalis* spp. *caurina*), a federally listed species (see Section 16.3.10 below for further discussion).

Species closely associated with deciduous forest and shrub habitats in the lease area include willow flycatcher (*Empidonax trailii*), yellow warbler (*Dendroica petechia*), MacGillivray's warbler (*Oporornis tolmiei*), black-capped chickadee (*Parus atricapillus*), red-eyed vireo (*Vireo olivaceous*), olive-sided flycatcher (*Contopus cooperi*), and ruffed grouse (*Bonasa umbellatus*).

Mammals

Large mammals in the lease area and surrounding vicinity include blacktailed deer (*Odocoileus hemionus columbianus*), elk (*Cervus elaphus*), black bear (*Euarctos americanus*), and mountain lion (*Felis concolor*). The lease sites fall within several big game emphasis area (Table 16.3-2).

Table 16.3-2
Big Game Emphasis Areas with the Proposed Lease Areas

Lease	Big Game Emphasis Area
OR 054587 S29	Whitewater, Mt Bruno
OR 054587 S3	Mt Bruno, Minto
OR 054587 S2	Minto, Red Grizzly

Furbearer species in the lease area include river otter (*Enhydra lutra*), beaver (*Castor canadensis*), raccoon (*Procyon lotor*), and coyote (*Canis latrans*). Wolverines (*Gulo gulo luteus*) have been documented in the region and may be occasional visitors to the lease area. Small mammals in the project vicinity are red tree vole (*Arborimus longicaudus)*, Townsend chipmunk (*Eutamias townsendi*), Trowbridge shrew (*Sorex trowbridgei*), deer mouse (*Peromyscus maniculatus*), snowshoe hare (*Lepus americanus*), Douglas squirrel (*Tamiasciurus douglasi*), and northern flying squirrel (*Glaucomys sabrinus*). Bats that may inhabit the vicinity include little brown myotis (*Myotis lucifugus*), long-eared myotis (*Myotis evotis*), silver-haired bat (*Lasionycteris noctivagans*), and Yuma myotis (*Myotis yumanensis*).

Impacts

Potential impacts on fish and wildlife could occur if reasonably foreseeable future actions were to:

- Adversely affect a population by substantially reducing its numbers, causing a fish or wildlife population to drop below self sustaining levels or causing a substantial loss or disturbance to habitat. Such effects could include vehicle impacts and crushing, increased predation, habitat fragmentation, or loss of seasonal habitat;

- Have a substantial adverse impact on nesting migratory birds, including raptors, as protected under the Migratory Bird Treaty Act;
- Interfere with the movement of any resident or migratory fish or wildlife species, or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites; or
- Conflict with the wildlife management strategies of the FS.

Alternative A (No Action)

The No Action alternative would have no impact on fish and wildlife.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on fish and wildlife; however, anticipated future actions following leasing would potentially result in impacts on fish and wildlife from future development of geothermal power plants within the lease sites that would disturb approximately 25 acres. Potential impacts that would affect all wildlife would result from:

- Habitat disturbance – The fragmentation of wildlife habitat for species requiring large contiguous tracts, such as elk, mountain lion, and black bear, can be affected by site clearing, well drilling, construction of access roads and geothermal facilities, as well as maintenance and operational activities. These activities could cause: disruption of breeding, foraging and migration, as well as mortality and injury of wildlife,
- Invasive Vegetation – Invasive species can affect wildlife by reducing habitat quality and species diversity; and affect foraging and breeding behavior.
- Injury or Mortality – Wildlife could be injured or killed during the clearing of roadways, vehicle staging, building construction, and other activities. Small mammals, reptiles and amphibians are most likely to be affected.
- Erosion and runoff – The effects of erosion include the loss of habitat for terrestrial species, and increased turbidity which can directly affect the resident salmonid species found in the lease are.
- Fire – Vehicles, electrical lines, and cigarette smoking can all result in accidental fires. During fires wildlife can be killed or injured. After fires wildlife may be forced to move to other habitats, or maybe be without suitable habitat for important behavioral activities.

- Noise – Construction and operation of geothermal facilities can produce noise far above normal ambient noise levels. Many species are sensitive to increases in noise that may cause disruption of breeding, migration, wintering, foraging, and other behavioral activities.
- Exposure to Contaminants – Vehicle fuel, hydraulic fluid, solvents, cleaners, and geothermal fluids can all be harmful to fish and wildlife. Accidental spills can contaminate soils and water and indirectly harm wildlife. Licensed herbicide use would likely be used to control vegetation around geothermal facilities and support structures. Spills of herbicides or acute exposure to herbicides can have adverse effects on wildlife.

Fish

Fish species in the North Santiam River could be affected by several activities. Impacts on fish and aquatic biota from development to the lease area would be linked to impacts on riparian habitats and immediately adjacent upland habitat. Ground disturbance, vegetation removal, ground water withdrawal, road construction and excavation, installation of structures and other facilities, such as transmission towers or pipelines, and release of water contaminants could affect fish species residing in streams in the project area, such as Chinook salmon; and cutthroat and rainbow trout, as well as resident sculpin and dace species. Changes in hydrology, increased turbidity, changes in water quality (temperature, dissolved oxygen, pollutants, etc), loss of riparian vegetation (an indirect aquatic food source), restriction of fish movement and migration, and changes in predator and human use of the aquatic habitat are all potential impacts associated with development of the lease area. The PEIS provides a more complete analysis of the potential impacts on fish resulting from geothermal activities, as well as impacts on riparian and wetland habitat that could affect fish and other aquatic biota.

Wildlife

Amphibians present in the lease area could be affected by any impacts that affect riparian habitat or water quality. Additionally, activities would result in direct mortality for amphibians and reptiles that would be crushed by equipment or entrapped in underground burrows.

The habitats within the lease area provides habitat for a variety of migratory birds. The FS is required to analyze the impacts of any action on migratory birds, under the Migratory Bird Treaty Act. The likelihood of disturbing nests of such birds is limited primarily to breeding and nesting seasons (spring and summer). Waterfowl, raptors, and small birds that depend on a particular forest types as a source of food or cover could be vulnerable to loss of habitat within the lease area. Removing timber and other vegetative cover affects foraging and nesting behavior. Lease stipulations to avoid disturbance during the migratory bird nesting season, so as not to violate the Migratory Bird Treaty Act, would reduce the potential for significant impacts on migratory birds.

The lease sites are located within several Big Game Emphasis Areas (Table 16.3-2). The lease sites provide foraging and wintering habitat for elk and deer. Habitat clearing and human activity associated geothermal projects could disturb elk, displacing them temporarily or permanently from otherwise suitable foraging habitats in and adjacent to the lease area. Geothermal activities associated with development of the lease site would also result in increased human activity and potentially increase recreational use of the area, which could directly affect big game populations.

16.3.10 Threatened and Endangered Species and Special Status Species

Setting

This section provides an overview of threatened, endangered, and special status species, and their habitats in the proposed lease area. Special status species are those identified by federal, state, or local agencies as needing additional management considerations or protection. The discussion of special status species is based primarily on analysis conducted for the Blowout Thin Project located approximately five miles west of the proposed lease sites, (US Forest Service 2007) as well as correspondence with NFS biologists regarding the lease area. Federal species are those protected under the Endangered Species Act and those that are candidates or proposed for listing under the Endangered Species Act. State sensitive species are those considered sensitive by the Oregon Department of Fish and Wildlife. Federally listed species with record of occurrence in the proposed lease area are discussed below (Table 16.3-3).

Harlequin Duck

Harlequin ducks use rivers, streams, and creeks as feeding habitat and commonly nest on banks. Shrubby riparian vegetation, lack of human disturbance, and loafing sites are important factors for harlequin ducks (Cassirer and Groves 1989). The North Santiam River that passes through the lease area provides nesting habitat for harlequin ducks during the breeding season. Grizzly Creek may also contain suitable habitat.

Northern Spotted Owl

The northern spotted owl was federally listed as threatened in Washington, Oregon, and California in July 1990 (55 FR 26114); it is an Oregon State endangered species. Factors that contributed to the federal listing were the declining population trends, the loss of suitable forested habitats throughout the species range, and the lack of adequate regulatory mechanisms to protect existing habitat for the species. Critical habitat was designated for the northern spotted owl in 1992 (57 FR 1796). Spotted owls are strongly associated with

Table 16.3-3
Federally Listed Species with Record of Occurrence and Potential to Occur in Lease Area

Species	Habitat Present in the Lease Sites?	Status		
		Federal	USFS – R6	State
Birds				
Harlequin duck	Yes	Candidate	Sensitive	N/A
Northern spotted owl	Yes	Threatened	N/A	Threatened
Northern bald eagle	Yes	Sensitive	N/A	Threatened
Yellow rail	No	N/A	Sensitive	N/A
Mammals				
California wolverine	Yes	Candidate	Sensitive	Threatened
Baird's shrew	Yes	N/A	Sensitive	N/A
Pacific Shrew	Yes	N/A	Sensitive	N/A
Pallid bat	Yes	N/A	Sensitive	N/A
Townsend's big eared bat	Yes	N/A	Sensitive	N/A
Reptiles and Amphibians				
Oregon slender salamander	Yes	N/A	Sensitive	N/A
Western pond turtle	Yes	N/A	Sensitive	Critical
Invertebrates				
Mardon skipper	No	Candidate	Sensitive	N/A

Source: US Forest Service 2007, 2008

mature and old-growth forests for nesting, foraging, and roosting. Nesting and roosting occur in a variety of coniferous forest types characterized by moderate to high levels of canopy closure; high density of standing snags; large diameter overstory trees with deformities, such as broken tops and witches' brooms; and abundant coarse woody debris on the forest floor (Courtney et al. 2004).

The lease sites are entirely within northern spotted owl critical habitat. The Northwest Forest Plan (US Forest Service 1994) serves recovery plan functions through specific management requirements, standards, and guidelines. The Jefferson LSR is expected to be a major contributor to spotted owl recovery as a source of owls dispersing to the north, southeast, south, and east.

Old growth is found throughout the lease area, and all lease sites are entirely within the Jefferson LSR. The lease site in section 29 is in Willamette Land and Resource Management Plan Management Area 7, Old Growth Grove. Direction from the management plan may prohibit any geothermal development within an old growth grove (Whitmore 2008). A spotted owl activity center is located in the center of the area on the west side of the river (US Forest Service 2008a). The lease area in Section 2 is also spotted owl critical habitat, and a spotted owl activity center is also located in the lease area located in Section 2 at the base of Minto Mountain.

California Wolverine (Gulo Gulo)

Wilderness or remote country where human activity is limited appears essential to the maintenance of viable wolverine populations. High elevation wilderness areas appear to be preferred in summer, which tends to effectively separate wolverines and humans. In winter, wolverines move to lower elevation areas which are snowbound with very limited human activity. Wolverines do not make much use of forests that are young and densely vegetated, nor do they make much use of clear-cut areas (Hornocker and Hash 1981).

Wolverines appear to be extremely wide-ranging, and unaffected by geographic barriers such as mountain ranges, rivers, reservoirs, highways, or valleys. For these reasons, Hornocker and Hash (1981) concluded that wolverine populations should be treated as regional rather than local.

Wolverine surveys were conducted on the Detroit Ranger District in a cooperative aerial survey effort with Oregon Department of Fish and Wildlife during the winters of 1997-98, 1998- 99, 1999-2000 and 2000-2001. Camera bait sets were used in 2002, 2003 and 2004 with no wolverines detected. Wolverine dens or tracks have not been located on the district (US Forest Service 2007).

Critical Habitat

The Endangered Species Act requires the federal government to designate critical habitat for any species listed under the Act. Critical habitat is any specific area within the geographical area occupied by the species at the time of listing under the Act containing physical or biological features essential to conservation, and those features require special management considerations or protection; as well as those areas outside the geographical area occupied by the species determined essential to conservation.

Critical habitat designations must be based on the best scientific information available, in an open public process, within specific timeframes. Before designating critical habitat, careful consideration must be given to the economic impacts, impacts on national security, and other relevant impacts of specifying any particular area as critical habitat. The Secretary of Commerce may exclude an area from critical habitat if the benefits of exclusion outweigh the benefits of designation, unless excluding the area will result in the extinction of the species concerned.

The Endangered Species Act protects threatened and endangered species in several ways. Under Section 7, all federal agencies must ensure that any actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of a listed species, or destroy or adversely modify its designated critical habitat.

Impacts

Title 16, United States Code, section 1531 *et seq.,* and Title 50, Code of Federal Regulations, part 17.1 *et seq.*, designate and provide for protection of threatened and endangered plant and animal species, and their critical habitat. The administering agencies are the U.S. Fish and Wildlife Service and the National Marine Fisheries Service Consultation pursuant to Section 7 of the Endangered Species Act would be performed prior to any ground-disturbing activity.

Potential impacts on threatened and endangered and special status species could occur if reasonably foreseeable future actions were to:

- Violate the Endangered Species Act, the BEPA, MBTA, or applicable state laws; or
- Decrease a plant or wildlife species population to below self-sustaining levels.

Alternative A (No Action)

The No Action alternative would have no impact on special status species.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on special status species; however, anticipated future actions would potentially result in impacts on special status species. Threatened and endangered species (including federal and state listed species and FS and BLM special status species) could be affected as a result of 1) habitat disturbance, 2) the introduction of invasive vegetation, 3) injury or mortality, 4) erosion and runoff, 5) fugitive dust, 6) noise, 7) exposure to contaminants, and 8) interference with behavioral activities.

Because of the regulatory requirements of the Endangered Species Act and various state regulations, and the requirements specified in BLM Manual 6840 Special Status Species Management and other resource-specific regulations and guidelines, appropriate survey, avoidance, and mitigation measures would be identified and implemented prior to any geothermal activities to avoid adversely affecting any sensitive species or the habitats on which they rely.

16.3.11 Historic and Scenic Trails

Setting

The Oregon section of the Pacific Crest National Scenic Trail traverses an area approximately two miles from the southeast corner of the SESE corner of T11S R7E S2. The Pacific Crest Trail spans 2,650 miles from Mexico to Canada, crossing through California, Oregon, and Washington. The trail passes through many historic and scenic areas, and is mainly contained within National Forests and protected wilderness. The Mt. Hood area is the chief attraction for the Oregon section of this trail, with 200 people annually attempting to complete the entire trail (US Forest Service 2008b).

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on historic or scenic trails.

Alternative B (Proposed Action)

Neither the Proposed Action nor anticipated future actions following leasing would have any impact on historic or scenic trails. No effects are expected to occur on the Pacific Crest Trail due to the lease sites being greater than the required one-mile buffer that is described in the PEIS to avoid impacts.

16.3.12 Cultural Resources

Setting

Cultural resources are past and present expressions of human culture and history in the physical environment and include prehistoric and historic archaeological sites, structures, natural features, and biota that are considered important to a culture, subculture, or community. Cultural resources also include aspects of the physical environment that are a part of traditional lifeways and practices and are associated with community values and institutions.

As in the PEIS, discussions relevant to cultural resources in this document are found in three sections. Traditional cultural resources and traditional cultural properties are addressed in Section 16.3.13, *Tribal Interests and Traditional Cultural Resources*. Section 16.3.11 addresses *Historic and Scenic Trails*. Cultural resources in this section include the physical remains of prehistoric and historic cultures and activities.

The pending lease application site is within the Plateau culture region, as described in the Appendix I of the PEIS. Zenk and Rigsby (1998) provides an ethnographic overview of the project area within the larger Plateau culture region. The following discussion is based primarily on that overview. The pending lease application site is considered to be within the traditional territory of Molala-speaking groups. Within the traditional territory, the project area is in an area where the Northern Molala dialect was spoken. Human occupation of the Plateau culture region began around 12,000 years ago although there is little archaeological evidence for very early human occupation compared to later time periods.

Molala extended-family groups wintered west of the Cascades summit in low elevations. Winter villages included semiexcavated wood plank houses. At other times of the year, individuals and families ranged to a variety of harvest localities from low-elevation prairies to collecting and hunting grounds in the High Cascades. Summer houses were constructed of bark or thatched-rush and resembled winter houses, but were not excavated. Large and small terrestrial mammals were hunted for subsistence, primarily deer and elk. The bow and arrow, snares, deadfalls, pitfalls, stalking, and tracking by dog were all used for hunting. Fish were hunted with harpoon, basketry traps, and weirs in the rivers while vegetal subsistence resources were collected in the prairies, savannas, and high elevations (Zenk and Rigsby 1998).

A variety of historic-era activities have been documented within the region. These included fur trapping and trade, mining, agriculture, fishing, emigration and settlement by Euro-Americans, missionization, and establishment of trails and railroads. Lewis and Clark may have been the first Euro-American to contact the Molalas. However, there is sufficient documentation to confirm that contact had been made by the 1840s when Euro-Americans began to settle in the Willamette Valley resulting in occasional conflicts between settlers and Molala people. The Dayton and Molala treaties of 1855 provided for the removal of Molalas to the Grand Ronde Reservation east of the project area. Primarily Northern Molalas moved to the reservation, but many others moved to other reservations in Oregon or maintained their own residences (Zenk and Rigsby 1998).

Data on cultural resources of the proposed lease area were provided in May 2008 by Cara Kelly, Zone Archaeologist for the Detroit and McKenzie River Ranger Districts of the Willamette National Forest. Collected data was recovered via a basic records search. No additional archaeological research or review of historic maps was done due to time constraints. Very little (less than 10-percent) of the lease sites have been previously surveyed. The single cultural resources survey that covers a small portion of the lease was conducted in 1990. Eleven cultural resources have been recorded within OROR 054587. All are unevaluated for National Register of Historic Places (NRHP)-eligibility and are therefore treated as NRHP-eligible until assessments show they are ineligible.

The majority of sites in the lease area are prehistoric lithic scatters. Site numbers for these resources are included in Table 16.3-4.

Two of the sites, the Newport Drive Historic Trail and FS Site No. 06180400389, are historic linear resources associated with pre-contact and historic trails. One additional resource, FS Site No. 06180400108 (Smithsonian Site No. 35 LIN 580), is an area of culturally modified trees.

Table 16.3-4
Lithic Scatters in the Proposed Lease Area

FS Site Number	Smithsonian Site Number
06180400076	35 LIN 633
06180400002	35 LIN 63
06180400003	35 LIN 64
06180400443	None
06180400058	None
06180400116	None
06180400057	35 LIN 374
06180400004	35 LIN 65

Consultation with federally recognized tribes that are affiliated with the lease area was initiated on September 12, 2007 to identify and assess historic properties that may be affected by the undertaking. No responses from the tribes have been received as of the date of publication; however consultation is considered on-going.

Until consultation with local Native Americans has been completed, it is unknown if there are Native American sites or sacred sites within or adjacent to the lease sites. The presence of cultural resources within portions of the sites not previously surveyed is also possible. Table 16.3-5 summarizes available data on the cultural resources of the proposed lease sites.

Table 16.3-5
Recorded Cultural Resources in the Proposed Lease Area

Lease OROR	Surveys (Percent)	NRHP-listed sites	NRHP-eligible sites	NRHP-ineligible sites	Unevaluated sites (Treated as NRHP-Eligible)
054587	<10%	N/A	N/A	N/A	11

Impacts

Alternative A (No Action)
The No Action alternative would have no impact on cultural resources.

Alternative B (Proposed Action)
The Proposed Action would not have any direct impact on cultural resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Completion of the Section 106 process of the National Historic Preservation Act requires the FS to consult with the State Historic Preservation Office, tribes and other parties to identify and assess historic properties affected by the undertaking and

develop measures to avoid, minimize, or mitigate any adverse effects of the undertaking on historic properties.

Given the density of unevaluated cultural resources and the lack of previous survey within the Willamette area leases, impacts on cultural resources could occur from subsequent permitted geothermal exploration, development, production and closeout through ground-disturbing activities, unauthorized actions and alterations to setting and cultural landscapes. The nature of these impacts is described in Chapter 4 of Volume I of the PEIS. Additionally, as described in Chapter 2 of Volume I of the PEIS, various areas of cultural resources would have No Surface Occupancy stipulations: National Landmarks, National Register Districts, NRHP-listed and -eligible sites and their associated landscapes, traditional cultural properties, Native American sacred sites, and areas with important cultural and archaeological resources. Areas of potential effect would include access roads, well pads, power plant footprints, pipeline and transmission line routes, and construction staging areas as well as the boundaries of cultural resources those facilities cross and the aspects of setting that contribute to significance. These areas of potential effect would be developed at the project-specific level, and would require inventories, evaluations, and appropriate treatments as outlined in the best management practices of Appendix D in Volume III of the PEIS. Under these cultural resources best management practices, the FS would also conduct Section 106 consultations with the State Historic Preservation Office, Native American tribes with ties to the project area, and local historic preservation groups to identify the presence and significance of cultural resources within or adjacent to the lease area and assess the level of impact of geothermal leasing and development on those resources. Project specific impacts after leasing would be reduced by implementing these best management practices.

16.3.13 Tribal Interests and Traditional Cultural Resources

Setting

Tribal interests include economic rights such as Indian trust assets, and resource uses and access guaranteed by treaty rights. Traditional cultural resources or properties include areas of cultural importance to contemporary communities, such as sacred sites or resource gathering areas. While most commonly considered in the context of Native Americans and Native Alaskans, there are traditional cultural resources associated with other ethnic or socially linked groups.

The pending lease application site is within the Plateau culture region, as described in the Appendix I of the PEIS. Zenk and Rigsby (1998) provide an ethnographic overview of the project area within the larger Plateau culture region. The pending lease application site is considered to be within the traditional territory of Molala-speaking groups. Within the traditional territory, the pending lease application site area is in an area where the Northern Molala dialect was spoken. Traditional collecting and hunting grounds were typically located in the High Cascades.

The Dayton and Molala treaties of 1855 provided for the removal of Molalas to the Grand Ronde Reservation east of the project area. Primarily Northern Molalas moved to the reservation, but many others moved to other reservations in Oregon or maintained their own residences (Zenk and Rigsby 1998).

Tribes with ties to the lease area include the Confederated Tribes of Grand Ronde Community of Oregon, the Confederated Tribes of Siletz Indians, the Confederated Tribes of Warm Springs Reservation of Oregon, and the Klamath Tribe. Consultation with federally recognized tribes that are affiliated with the lease area was initiated on September 12, 2007 to identify and assess tribal concerns and traditional resources that may be affected by the undertaking. No responses from the tribes have been received as of the date of publication; however, the consultation process is considered on-going. While many traditional cultural resources are well known, some locations or resources may be privileged information that is restricted to specific practitioners or clans. For tribes, maintaining confidentiality and customs regarding traditional knowledge may take precedence over identifying and evaluating these resources, unless they are in imminent danger of damage or destruction.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on tribal interests and traditional cultural resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on tribal interests and traditional cultural resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Impacts on tribal interests and traditional cultural resources are assessed using the criteria found in Chapter 4 of Volume I the PEIS. Because issuing geothermal leases confers on the lessee a right to future exploration and development of geothermal resources within the lease area, it is a commitment or granting of a right that may interfere with other uses or interests. Although no tribal interests or concerns have been identified by the consultation process, the process is considered on-going and such resources may be identified in the future by tribes. Impacts on tribal interests would be minimized or avoided by implementing best management practices in Appendix D of Volume III of the PEIS for each of the phases of the Reasonably Foreseeable Development scenario as described in Chapter 2 of Volume I of the PEIS.

For traditional cultural resources, completion of the Section 106 process of the National Historic Preservation Act requires the BLM and FS to consult with the State Historic Preservation Office, tribes and other parties to identify and assess historic properties affected by the undertaking and develop measures to avoid, minimize, or mitigate any adverse effects of the undertaking on historic properties which includes traditional cultural properties. No Traditional Cultural Resources have been identified by consulted tribes thus far, but consultation is considered on-going. Additionally, archaeological resources such as those discussed in Section 16.3.12, *Cultural Resources*, are often considered traditional resources by tribes.

Impacts on traditional cultural resources could occur from subsequent geothermal exploration, development, production and closeout through ground-disturbing activities, unauthorized actions and alterations to setting and cultural landscapes. The nature of these impacts and mitigations are described in Chapter 4 of Volume I of the PEIS. Areas of potential effect would include access roads, well pads, power plant footprints, pipeline and transmission line routes, and construction staging areas as well as the aspects of setting that contribute to significance. These areas of potential effect would be developed at the project-specific level, and would require inventories, evaluations, and appropriate treatments as outlined in the best management practices of Appendix D in Volume III of the PEIS. Under these cultural resources best management practices, the FS would also conduct Section 106 consultations with the State Historic Preservation Office, Native American tribes with ties to the project area, and local historic preservation groups to identify the presence and significance of cultural resources within or adjacent to the lease area and assess the level of impact of geothermal leasing and development on those resources. Project specific impacts after leasing would be reduced by implementing these best management practices.

16.3.14 Visual Resources

Setting

This section describes the visual resources in the region of influence (ROI), which is defined as the areas within and immediately surrounding the proposed lease area. Described below is the method for managing scenic resources and the visual landscape of the lease area.

The Forest Service's Scenery Management System is the current method for inventorying and managing scenic resources in National Forests. It is described in Chapter 3 of Volume I of the PEIS under *Visual Resources*. The scenery of the Forest, however, is managed through the application of the older Visual Management System (Agricultural Handbook - 462, National Forest Landscape Management, Volume 2, Chapter 1, The Visual Management System). The Visual Management System (VMS) was adopted by the Forest Service in 1974. The key component of the VMS is the establishment of Visual Quality Objectives (VQOs) within the Land and Resource Management Plan.

There are five differing levels of VQOs: Preservation, Retention, Partial Retention, Modification, and Maximum Modification. The following is a brief description of the five VQOs:

- Preservation – Allows ecological change only. Management activities are prohibited except for very low visually impacting recreation facilities.
- Retention – Management activities may not be visually evident. Contrasts in form, line, color and texture must be reduced during or immediately after the management activity.
- Partial Retention – Management activities must remain visually subordinate to the characteristic landscape. Associated visual impacts in form, line, color and texture must be reduced as soon after project completion as possible but within the first year.
- Modification – Management activities may visually dominate the characteristic landscape; however, landform and vegetative alterations must borrow from naturally established form, line, color or texture so as to blend in with the surrounding landscape character. The objective should be met within one year of project completion.
- Maximum Modification – Management activities including vegetative and landform alterations may dominate the characteristic landscape. However, when viewed as background they must visually appear as natural occurrences within the surrounding landscapes or character type. When viewed as foreground or middle ground, they may not appear to completely borrow from naturally established form, line, color, or texture. Alterations may also be out of scale or contain detail which is incongruent with natural occurrences as seen in foreground or middle ground. Reduction of contrast should be accomplished within five years.

Additionally, Agricultural Handbook - 478, National Forest Landscape Management, Volume 2, Chapter 2: "Utilities" (1975) also contains guidelines for managing visual resources with respect to utilities.

The northern lease sites have mostly Modification and Retention VQOs. There is also a portion with a Preservation VQO. The southern lease sites have mostly Modification and Retention VQOs. There is also a portion with a Partial Retention VQO.

According to the Land and Resource Management Plan Final Environmental Impact Statement for the Willamette National Forest, the landscape of the Forest is composed of dense coniferous vegetation, varied terrain, an abundance of geologic features, lakes and rivers, wildlife, and snow-capped mountain peaks (US Forest Service 1990). This resource provides a broad range of natural and managed scenic experiences for both local and distant visitors. The scenery of the Forest is an important asset to the local communities.

The western Cascades landscape type is oriented in a north-south direction and occupies the western two-thirds of the Forest (US Forest Service 1990). It is characterized by a general conformity in ridge crests separated by deep valleys with moderately steep, highly dissected, side slopes. In the southern portion of this landscape type, the major valleys are V-shaped. Some rock cliffs and rock outcrops exist. Vegetation is characterized by dense stands of large trees including western hemlock, Douglas-fir, and true fir. Most areas have a continuous cover of overstory and understory vegetation. Deciduous species such as alder and maple are often intermixed along drainages. Some meadows are found in both lower and upper elevations.

A wide variety of rock formations exist in the area but most are hidden by the dense vegetative cover (US Forest Service 1990). Some extensive bare rock ridges and volcanic plugs stand out above the vegetation, and old volcanic lava flows are sparsely vegetated. Water bodies, particularly lakes, ponds, and marshes are scarce within this landscape character type. Other waterforms consist of streams and major rivers, all of which drain in to the Willamette Basin.

The visual experience of Forest visitors in this landscape type is characterized by views that are focused or directed at points or features in the landscape by road and trail side vegetation or landform structure (US Forest Service 1990). To a lesser extent, visitors will also experience landscape spaces enclosed by a continuous physical barrier of trees, hills, or mountains.

The proposed lease sites are approximately 5 to 8 miles west of the summit of Mt. Jefferson (approximately 10,500 feet), approximately 8 to 10 miles southeast of the town of Detroit, and straddle Highway 22 and Santiam River. Tributaries of the Santiam River also cross the lease area. Prominent peaks near the lease sites are Mount Bruno (approximately 5,300 feet), Woodpecker Hill (approximately 5,000 feet), Minto Mountain (approximately 5,100 feet), and lizard Ridge (approximately 5,600 feet).

The sloped terrain found in the lease sites are mostly covered with a coniferous forest of varying heights and maturity, except where a patchwork of clear cuts occurs. Strings of dirt roads for logging cover the lease sites.

Human-made modifications to the visual landscape are limited to roads of various conditions and recreation areas. Hiking, backpacking, and snowshoeing activities occur in all of the lease sites. There is a trail (#3448) in the most eastern parcel proposed for geothermal leasing. Riverside Campground is next to Highway 22 and is also in a lease area. With the exception of Highway 22, there are no sources of light in the lease sites.

Highway 22 is a National Scenic Byway (US Department of Transportation 2008a). It is 220 miles long and offers views of waterfalls, ancient forests, rushing whitewater, placid lakes, and snowcapped volcanic peaks (US Department of Transportation 2008b).

Impacts

Alternative A (No Action)

There would be no impacts on, or changes to visual resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on visual resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. The potential risk of changes affecting visual resources is assessed for five significance criteria, which are described in the PEIS. Future actions based on the Reasonably Foreseeable Development scenario could result in changes that impact visual resources.

Future geothermal development activities could involve new structures, roads, and operations that are described in the Reasonably Foreseeable Development scenario. The new structures, roads, and operations would alter the characteristic landscape and be sources of light and glare. Depending on their exact location, they could also diminish scenic views. These impacts would be noticeable, because they would be near areas where recreation takes place and near areas where minimal nearby development exists. The impacts would also be near a scenic byway. Although stipulations outlined in Appendix B of the PEIS would minimize these impacts, geothermal resource development activities would be visually evident. Changes to visual resources based on the reasonable development scenario would result in impacts on visual resources that would not be consistent with Retention and Preservation VQOs.

It is assumed the stipulations would result in positioning new structures, roads, and operations in the landscape so they would remain visually subordinate to the characteristic landscape and would result in landform and vegetative alterations that blend in with the surrounding landscape character. As a result, changes to visual resources based on the reasonable development scenario would result in impacts on visual resources that would be consistent with Partial Retention and Modification VQOs.

16.3.15 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

Setting

The leasing area covers approximately 1,115 acres within Linn County, Oregon. Linn County was selected as the Region of Influence for socioeconomic analysis as the impacts of leasing are likely to occur within this region. A summary of the population, housing, employment, local school data and low-income and minority populations for the County is provided based primarily on data from Census 1990 and 2000 population, demographic and housing information (US Census Bureau 1990, 2000).

Population

In 2006, population in Linn County was estimated at 111,489 (US Census Bureau 2008). This represents an 8.2 percent increase in population from 2000, when the total population within the county was approximately 103,069. Between 1990 and 2000 population increased by approximately 7.5 percent. Current population trends are expected to continue (US Census Bureau 1990, 2000).

Housing

In 2000, there were 42,521 total housing units; 39,541 of these were occupied and 26,854 owner occupied, with a homeowner vacancy rate of 2.2 percent and a rental vacancy rate of 9.2 percent. In 1990, there were 36,482 total housing units, of which 34,716 units were occupied and 22,757 owner occupied. In 1990 the homeowner occupancy rate was 1.2 percent and the rental vacancy rate was 4.3 percent (US Census Bureau 1990, 2000).

Employment

In 2000 the workforce consisted of 50,105 individuals, of which 3,931 people, or 7.8 percent were unemployed. This is consistent with 1990 data, when the workforce consisted of 42,851 people, of which 3,354 or 7.8 percent were unemployed. Median household income was $37,518. In1990 median family income was $29,421.

Based on 2000 data, the industries employing the greatest percent of the population include manufacturing (21.6 percent), educational, health and social services (19 percent); retail trade (11.7 percent); and construction (7.7 percent) (US Census Bureau 1990, 2000).

Schools and Public Infrastructure

In 1990, 15,646 students were enrolled in K-12 education in Linn County. In 2000 this number increased to 19,774 students (US Census Bureau, 1990, 2000). School Districts within Linn County include Central Linn, Greater Albany Harrisburg, Santiam Canyon, Sweet Home, and Linn Benton.

Environmental Justice

Whites of non-Hispanic origin account for approximately 94.9 percent of the population of Linn County based on the most current data available (US Census Bureau 2008). The minorities with the largest presence in the local population are people of Hispanic/Latino descent (5.6 percent) and American Indian or Alaskan Natives (1.2 percent) (US Census Bureau 2008). Additional details are provided in Table 16.3-6, below.

In 1999, 11,618 people, or 11.4 percent of the population were living below the poverty level in Linn County. This was a slight decrease from 1990, during which survey approximately 12,178 individuals or 13.5 percent of the population was living below poverty level (US Census Bureau 1990, 2000).

Table 16.3-6
Race/Ethnicity in Linn County

	1990	2000	Percent Change (%)
Total Population	91,227	103,069	7.5 %
White	88,364	96,059	87 %
Black/African American	182	327	79 %
American Indian/Alaskan Native	1056	1313	24 %
Asian	799	799	0 %
Pacific Islander*	N/A	151	N/A
Other	826	1855	125 %
Two or more*	N/A	2,565	N/A
Hispanic or Latino**	2,177	4,514	107 %

Source: US Census Bureau 1990, 2000.
* Not reported on1990 census: Asian and Pacific Islanders were one group and more than one race was not an option.
** In combination with other race. Totals may add to more than 100 percent as individuals can report more than one race.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on existing socioeconomics in Linn County, Oregon. No impacts would occur to minority or low income populations.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on socioeconomics or environmental justice; however, geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Impacts include a potential increase in jobs and decrease in unemployment in Linn County due to construction and operations and maintenance jobs at a newly developed geothermal plant. Given the reported unemployment rate of 11.4 percent in 2000, and the small size of the proposed plants, it is not likely that jobs created by the proposed action would require a large population influx. As a result, impacts on local schools or other public infrastructure would be minimal.

Geothermal development would also be a positive stimulus to the local economy through tax revenues for Linn County and the State of Oregon.

The Reasonably Foreseeable Development scenario predicts one 20 MW plant and one 30 MW plant will be developed in the lease area for electricity generation. Impacts of a standard 50 MW plant are discussed in Chapter 4 of the PEIS, *Socioeconomics and Environmental Justice*. Similar impacts to those discussed in the PEIS are likely for this lease area; however, impacts would be reduced according to the smaller MW capacity of the plants in the lease area.

Due to the absence of residences in and around the lease area, impacts on low income or minority populations would be minimal.

16.3.16 Noise

Setting

Current sources of noise in the lease site are limited to wind, dispersed recreational use, traffic from Highway 22, logging roads, camping at the Riverside campground, and wildlife. Sources of noise originating outside of the lease sites but affecting the lease sites include traffic from logging roads and air traffic. Sensitive noise receptors are generally considered to be homes, hospitals, schools, and libraries, but can also include recreational facilities, where a quiet environment is vital to the natural setting and recreational experience. Aside from the Riverside campground located at the south end of Section 3, no other buildings or developments are within one mile of the site. The Riverside campground is the only identified sensitive noise receptor.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on noise.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on noise; however, geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Geothermal activities in the south portion of Section 3 could adversely impact the quality of recreational experience currently possible at the Riverside campground. The prohibition of geothermal activities within a quarter mile of the Santiam River due to its eligibility as a Wild and Scenic River would eliminate any noise impacts on the campground.

Geothermal activities in sections 3 and 29 could impact the Outstanding Remarkable Values for the North Santiam River, as a river that is eligible for designation as a Wild and Scenic River. The prohibition of geothermal activities within a quarter mile of the river would reduce such noise impacts.

SECTION 16.4
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CHAPTER 17

MT. BAKER-SNOQUALMIE NATIONAL FOREST

SPOKANE DISTRICT

ANALYSIS FOR PENDING LEASE APPLICATIONS:

WAOR 056025, WAOR 056027, WAOR 056028, WAOR 056029

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SECTION 17.1
INTRODUCTION

17.1.1 INTRODUCTION

This lease-specific analysis describes the environmental effects of leasing approximately 9,450 acres of NFS land within the Mount Baker District of the Mount Baker-Snoqualmie National Forest and the BLM Spokane District to private industry for the development of geothermal resources.

This lease-specific analysis serves as an information resource to aid decision-makers in determining whether these lands are appropriate for leasing under FS and BLM management policies and existing environmental regulations.

The lease sites are within the Mount Baker Ranger District of the Mount Baker-Snoqualmie National Forest, which is the surface management agency for the lease sites. Subsurface mineral rights are managed by the BLM Spokane District. The BLM issues leases with the consent of the FS (Regional Forester upon recommendation from the Mt. Baker-Snoqualmie NF Supervisor) for the lands under application on the Mount Baker-Snoqualmie NF.

17.1.2 LOCAL REGULATORY CONSIDERATIONS

The pending lease application sites are located within Whatcom County, Washington and are subject to state and local regulations, as described below.

State of Washington Renewable Portfolio Standard Program

The Washington Renewable Portfolio Standard Program is a Washington law that requires investor-owned utilities to obtain 15 percent of the power supplied to customers to be generated from renewable resources by 2015. Geothermal energy is included in the definition of renewable resources under the program.

Mount Baker-Snoqualmie National Forest Land and Resources Management Plan (1990)

The Mt. Baker-Snoqualmie National Forest Land and Resources Management Plan (Forest Plan) guides all natural resource management activities and establishes management standards and guidelines for the Mt. Baker-Snoqualmie National Forest. It describes resource management practices, levels of resource production and management, and the availability and suitability of lands for resource management.

The Forest Plan identifies the following forest-wide standards and guidelines that apply to geothermal activity:

- An appropriate environmental analysis and documentation will be used as a basis for making recommendations in leasing or licensing and in determining necessary stipulations for the protection of other resources. FW-297 – Permits for leasable minerals shall provide for protection and rehabilitation of surface resources.
- Processing and administration of all mineral, oil and gas and geothermal leases, exploration proposals, and development proposals will be in accordance with State and Federal rules, regulations, and standards.
- Mineral exploration and mineral removal are permitted throughout the forest, except withdrawn areas.
- All activities which involve significant disturbance of the surface resources require a notice of intent and/or an operating plan be submitted and processed in accordance with 36 CFR 228.E
- Reclamation standards will be developed to insure land restoration to a productive condition to the extent practicable. Opportunities to enhance other resources will be considered. Concurrent reclamation will be required and bonded.
- Withdrawal of lands from appropriation or entry under the mining or mineral leasing laws will be in accordance with Section 204 of FLMPA. Areas with mineral potential will be recommended for withdrawal from mineral entry when mitigation measures would not adequately protect other resource values which are of greater public benefit.
- For mineral lease applications submitted by BLM, appropriate stipulations will be required for leases as necessary to achieve Management Area prescriptions. "No surface occupancy" stipulations will be incorporated in lease recommendations when: (a) surface occupancy would cause significant resource disturbance which cannot be mitigated by other means; (b) where resource impacts would be irreversible or irretrievable; or (c) the activity proposed is incompatible with the surface management prescription.

Spokane Resource Management Plan (1985)

The lease area is within the BLM Spokane District. The Spokane RMP was developed to provide a comprehensive framework for managing and allocating public land and resources in the Spokane District. It serves as a master plan that provides a framework within which more site-specific decisions can be made regarding conditional or prohibited uses and activities in some sites. It serves to define the intensity of management of various resources, the development of activity plans such as grazing allotment management plans and habitat management plans, and the issuance of rights-of-way, leases, or permits.

The Leasable Minerals section of the Spokane RMP states the following three objectives:

- Maintain exploration and development opportunities for leasable and locatable energy and mineral resources.
- Provide opportunities for extraction of salable minerals by other government entities, private industry, individuals, and nonprofit organizations.
- Continue to make available mineral resources on the reserved federal mineral estate.

The RMP includes the following Management Actions/Direction regarding leasable minerals:

- All energy leasable minerals (oil, gas, and geothermal) fall under regulations in 43 CFR 3100 and 3200.
- Leasable mineral operations are covered under the District's oil and gas EA which has identified areas of environmental concern
- BLM requires a cultural evaluation prior to entry.
- General stipulations (such as identifying cultural resource potential, endangered, threatened, or sensitive species clearance) are to be established at the time of lease issuance.

Northwest Forest Plan (1994)

The Northwest Forest Plan (NWFP) is an overall vision for the Pacific Northwest that would produce timber products while protecting and managing impacted species. The Plan focuses on the following five key principles:

- Never forget human and economic dimensions of issues;
- Protect long-term health of forests, wildlife, and waterways;
- Focus on scientifically sound, ecologically credible, and legally responsible strategies and implementation;
- Produce a predictable and sustainable level of timber sales and non-timber resources; and
- Ensure that Federal agencies work together (US Forest Service 1994a).

The mission of the NWFP is to adopt coordinated management direction for the lands administered by the FS and the BLM and to adopt complimentary approaches by other Federal agencies within the range of the northern spotted owl. The management of these public lands must meet dual needs: the need for forest habitat and the need for forest products. With the signing of the Northwest Forest Plan Record of Decision in 1994, a framework and system of Standards and Guidelines were established, using a new ecosystem approach to address resource management.

The NWFP includes the following Standards and Guidelines that apply to geothermal development in Late-Successional Reserves:

> Mining - The impacts of ongoing and proposed mining actions will be assessed, and mineral activity permits will include appropriate stipulations (e.g., seasonal or other restrictions) related to all phases of mineral activity. The guiding principle will be to design mitigation measures that minimize detrimental effects to late-successional habitat.

The NWFP includes the following management measures that apply to geothermal development in Riparian Reserves:

MM-1. Require a reclamation plan, approved Plan of Operations, and reclamation bond for all minerals operations that include Riparian Reserves. Such plans and bonds must address the costs of removing facilities, equipment, and materials; recontouring disturbed areas to near pre-mining topography; isolating and neutralizing or removing toxic or potentially toxic materials; salvage and replacement of topsoil; and seedbed preparation and revegetation to meet Aquatic Conservation Strategy objectives.

MM-2. Locate structures, support facilities, and roads outside Riparian Reserves. Where no alternative to siting facilities in Riparian Reserves exists, locate them in a way compatible with Aquatic Conservation Strategy objectives. Road construction will be kept to the minimum necessary for the approved mineral activity. Such roads will be constructed and maintained to meet roads management standards and to minimize damage to resources in the Riparian Reserve. When a road is no longer required for mineral or land management activities, it will be closed, obliterated, and stabilized.

MM-4. For leasable minerals, prohibit surface occupancy within Riparian Reserves for oil, gas, and geothermal exploration and development activities where leases do not already exist. Where possible, adjust the operating plans of existing contracts to eliminate impacts that retard or prevent the attainment of Aquatic Conservation Strategy objectives.

MM-6. Include inspection and monitoring requirements in mineral plans, leases or permits. Evaluate the results of inspection and monitoring to effect the modification of mineral plans, leases and permits as needed to eliminate impacts that retard or prevent attainment of Aquatic Conservation Strategy objectives.

17.1.3 Scope of Analysis and Approach

This lease-specific analysis incorporates by reference the programmatic analysis presented in Volume I. This analysis examines the cluster of four pending lease application sites, describes the Reasonably Foreseeable Development scenario for this cluster, examines the existing environmental setting, and describes the potential direct and indirect impacts that issuing leases, and anticipated future actions following leasing, would have on the human and natural environment.

This report focuses on specific key resource concerns in the cluster, and incorporates by reference the impacts described in the PEIS. Decision-makers should consider both the impacts described in this analysis, in addition to those described in the main body of the PEIS. The analysis presented here does not reiterate the details of impacts identified in the PEIS, but rather refers to them as they arise in the impact analysis for pending lease application sites addressed here. Mount Baker-Snoqualmie National Forest staff members were contacted during the preparation of this analysis to help identify local resource concerns.

17.1.4 Cumulative Actions

Consultation with the Mount Baker-Snoqualmie National Forest did not identify any projects that would cumulatively contribute to impacts within the project area.

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SECTION 17.2
PROPOSED ACTION AND ALTERNATIVES

17.2.1 INTRODUCTION

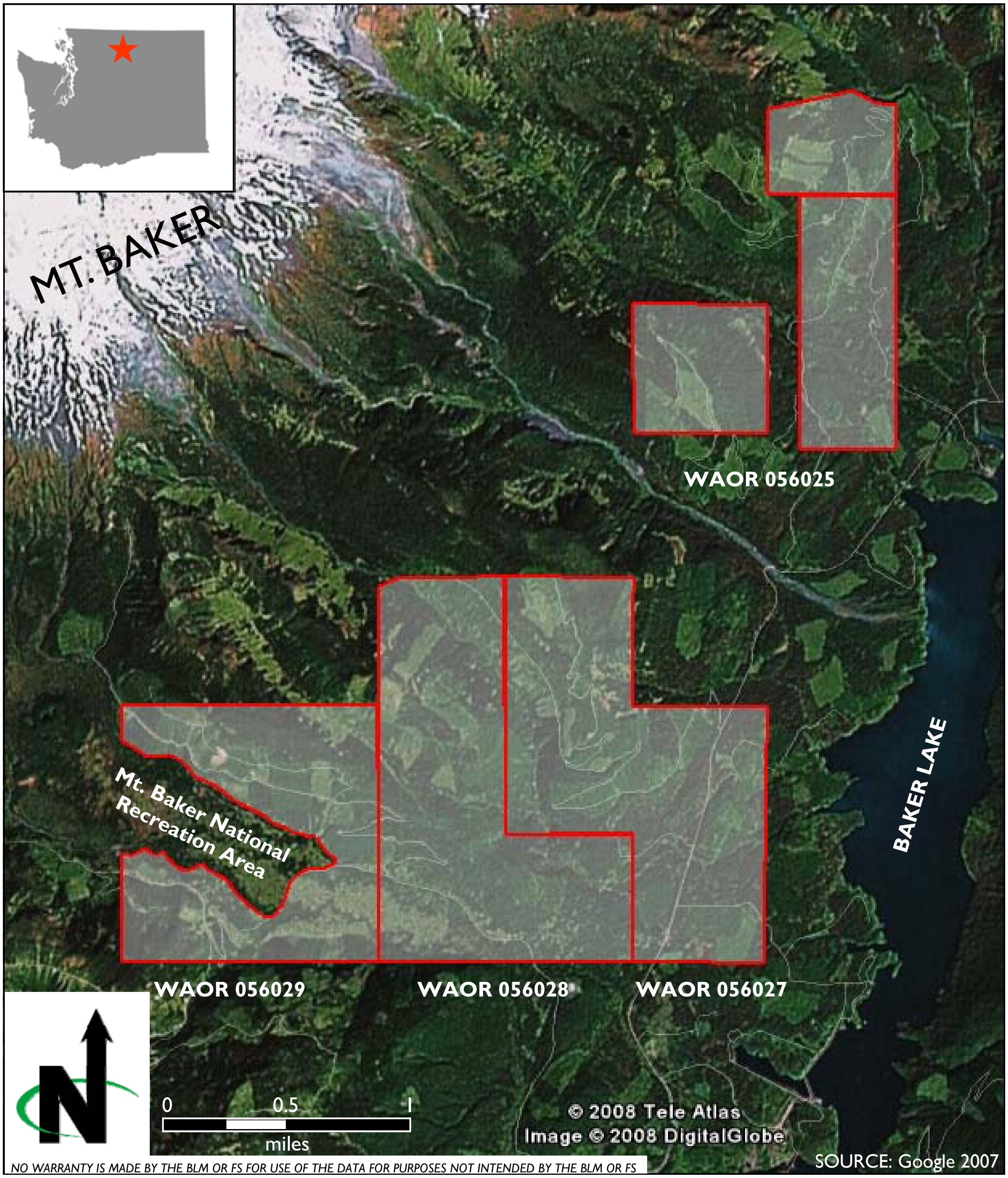
This chapter provides the details of the proposed action, alternatives to the proposed action, and an overview of the reasonably foreseeable develop (Reasonably Foreseeable Development) scenario for pending lease application sites WAOR 056025, 056027, 056028, and 056029.

17.2.2 PROPOSED ACTION

The proposed action is (1) for the Forest Service to issue a consent determination to the BLM to issue leases to the lease applicant for three areas within the Mount Baker National Forest and Spokane/Wenatchee BLM District; and (2) the BLM to issue said leases. The 9,450.2 acres of land are in the southeastern foothills of Mount Baker, in Whatcom County, Washington (see Figure 17-1). Lease boundaries could be adjusted in the decision to avoid unacceptable impacts on sensitive resources.

Four pending lease applications are included within this area:

- WAOR 056025 – 2,403 acres comprise portions of three adjacent sections of land and a full fourth section 0.25 mile to the west. The legal description of this land is (1) T38N R8E S36; (2) T38N R9E S19, "part so of wilderness"; (3) T38N R9E S30, parts E2, E2W2, Lots 1-4; (4) T38N R9E S31, parts E2, E2W2, Lots 1-4.
- WAOR 056027 – 2,560 acres comprised of four contiguous sections of land. The legal description of this land is (1) T37N R8E S11; (2) T1S T37N R8E S13; (3) T37N R8E S14; (4) T37N R8E S24.
- WAOR 056028 – 2,544.970 acres comprised of four contiguous sections of land. The legal description of this land is (1) T37N R8E S10, "pt outside NRA"; (2) T37N R8E S15; (3) T37N R8E S22; (4) T37N R8E S23.



C://EMPSi/GeothermalPEIS/Figures

All 3 lease sites are within the Mt. Baker-Snoqualmie National Forest.

LEGEND:
Lease site boundary

Mt. Baker Lease Locations
WAOR 056025, 056027, 056028, 052029
Mt. Baker-Snoqualmie NF / Spokane District

Figure 17-1

- WAOR 056029 – 1,941.920 acres comprised of four contiguous sections of land with a portion of each excluded due to the excluded land being a National Recreation Area. The legal description of this land is (1) T37N R8E S16, "pt outside NRA"; (2) T37N R8E S17, "pt outside NRA"; (3) T37N R8E S20, "pt outside NRA"; (4) T37N R8E S21, "pt outside NRA".

The lease sites range in elevation from 800 feet to 3,400 feet above mean sea level and are traversed by several creeks, roads and trails. Other land uses include several gravel pits and quarries. There are no known buildings within the lease sites or within 0.5 mile of any of the lease sites.

17.2.3 ALTERNATIVES

Two alternatives are considered in this analysis: Alternative A, the No Action alternative, and Alternative B, Leasing with Stipulations.

Alternative A: No Action

Under Alternative A, the BLM would deny the four pending lease applications.

Alternative B: Leasing with Stipulations

Under Alternative B, the FS would provide a consent determination for the lease applications, and the BLM would issue the leases with the stipulations identified in Chapter 2 of the PEIS.

17.2.4 REASONABLY FORESEEABLE DEVELOPMENT SCENARIO

All of the lease sites are likely to be developed for electricity generation. The pending noncompetitive lease applications were filed by Vulcan Power Corporation in 2000. It is expected that issuing all of the leases in this area would result in two binary power plants at capacities of 30 and 20 megawatts. It is expected that a 30 megawatt plant would result in 15 acres of land disturbance, and a 20 megawatt plant would result in 10 acres of land disturbance for a total disturbance of 25 acres. Existing Forest Service roads would be used to access the sites.

Exploration activities for a 20 megawatt plant and a 30 megawatt plant is expected to involve approximately 12 temperature gradient holes, disturbing approximately 0.15 acre each, for a total disturbance of approximately 2 acres. Disturbance would result from the types of activities described under Chapter 2 of the PEIS under *Phase One: Geothermal Resource Exploration*.

Assuming that a commercially viable resource is found within both portions of the lease area identified as being suitable, drilling operations and development of the site would be expected to result in a further approximately 8 acres of land disturbance (roughly 5 acres for the 30 megawatt plant and 3 acres for the 20 megawatt plant) from the types of activities described in the Reasonably

Foreseeable Development scenario of Chapter 2 of the PEIS under *Phase Two: Drilling Operations*.

Utilization, the third phase of a geothermal project, is expected to result in a further approximately 15 acres of land disturbance (roughly 9 acres for the 30 megawatt plant, and 6 acres for the 20 megawatt plant) from the types of activities described in the Reasonably Foreseeable Development scenario of Chapter 2 of the PEIS under *Phase Three: Utilization*. The length and alignment of transmission lines are not estimated here since these factors would depend upon the positioning of any power plant and the distance to the nearest electrical tie-in.

Reclamation and abandonment, the fourth phase of a geothermal project, is expected to result in temporary disturbance of all originally disturbed acres, after which, the site would graded and vegetated to pre-disturbance conditions, as described in the Reasonably Foreseeable Development scenario of Chapter 2 of the PEIS under *Phase Four: Reclamation and Abandonment*.

SECTION 17.3
AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

17.3.1 INTRODUCTION AND GEOGRAPHIC SETTING

The following resource disciplines are not addressed in this section because they are not found in the leasing areas and are not relevant to the discussion: wild horses or burros, livestock grazing, historic or scenic trails, and special designations.

All the pending lease applications are in geologic units that would be expected to have a relatively low potential for containing vertebrate fossils or scientifically significant invertebrate or plant fossils; therefore, paleontological resources are not analyzed in detail. Paleontological mitigative procedures outline in the PEIS would be followed for all ground distributing activities. Protective measures outlined in the PEIS would be applied.

Future development of the proposed lease sites would also yield the same health and safety impacts as identified in Chapter 4 of Volume I of the PEIS and therefore is not repeated in this lease-specific analysis.

17.3.2 LAND USE, RECREATION AND SPECIAL DESIGNATIONS

Setting

This section is a discussion of the current land ownership and use within the Region of Influence (ROI) for the four lease sites that are part of the proposed action. The ROI is the land area within and adjacent to the potential lease sites.

Policies and Plans

It is the policy of the Department of the Interior, consistent with Section 2 of the MMPA and Sections 102(a) (7), (8) and (12) of FLPMA, to encourage the development of mineral resources, including geothermal resources, on federal lands. The Geothermal Steam Act of 1970 provides regulatory guidance for geothermal leasing by the BLM. The pending lease application sites are located within the Mount Baker-Snoqualmie National Forest, which is managed under the Mount Baker-Snoqualmie National Forest Land and Resource Management Plan (Forest Plan). The Forest Plan, as amended by the Northwest Forest Plan has the stated goal to, "*provide for exploration, development, and production of mineral and energy resources while minimizing effects on the surface resources*" (US Forest Service 1994b). Standards and guidelines in the Forest Plan for leasable mineral operations are discussed in Chapter 1.

Regional Setting

The lease area consists of approximately 9,450 acres of NFS land in three areas of the southeastern foothills of Mount Baker. The lease area is within in the Mount Baker District of the Mount Baker-Snoqualmie National Forest, in Whatcom County, Washington. Land within and adjacent to the lease area is primarily NFS land, with some private parcels interspersed.

The lease area and Mount Baker-Snoqualmie NF region is within 70 miles of more than 3 million people in the metropolitan areas of central Puget Sound. Bellingham is approximately 30 miles from the lease sites with a population of 67,000.

One campground occurs near lease site WAOR 056025 and is described below. No other campgrounds occur within 0.5 mile of the lease sites. One trailhead, for Boulder Ridge trail, occurs within the lease sites.

Mount Baker National Recreation Area abuts the center portion of all four sections in lease WAOR 056029 and the NW corner of section 10 in lease WAOR 056028. This National Recreation Area was created to accommodate and preserve the winter snowmobile use of the Mount Baker area. Management of the area focuses on providing snowmobile and cross-country skiing opportunities during the winter and non-motorized recreational uses during the summer season. During the summer months the area is used for hiking, and backcountry camping at designated sites (US Forest Service 2007).

In addition to activities described at the designated recreation areas, dispersed recreation occurs throughout the lease area. Popular forms of recreation in the Forest include hiking, hose-back riding, hunting, and fishing.

At its closest, the North Cascades National Park is approximately 1.9 miles to the northeast from lease site WAOR 056025. The lease site is separated from the National Park by a river and a drop in topography from approximately 1,600 feet above mean sea level (amsl) at the lease site, to approximately 1,300 feet amsl at the river, and back up to approximately 1,800 feet amsl at the National Park boundary.

Lease Areas

According to the Northwest Forest Plan, all sites are in a Late-Successional Reserve, and Sulfur Creek Botanical Area (8C) is present in relatively small parts of sites WAOR 056028 and 056029. Riparian reserves are present throughout the lease areas. None of the lease sites are within Key Watersheds. Riparian Reserves are abundant throughout the lease sites. In addition, some sites are within or adjacent to Inventoried Roadless Areas and the Mt. Baker Wilderness Area, thereby limiting accessibility to the sites.

WAOR 056025

The northern portion of Section 19 lease area borders the Mt. Baker Wilderness Area. Baker Hot Springs is located just to the east of the SE quarter of the same section (the hot springs are not in the lease site). NFD 1130 and 1144 provide access to section 30 and 31. A quarry is found in the NW quarter of Section 30 and a gravel pit in SE quarter of Section 31. The only feature of note in Section 36 is NFD 1131.

The closest campground to the lease sites is approximately 0.3 mile east of Section 31 between NFD 1144 Road and Park Creek. The trailhead for Boulder Ridge trail is within Section 36.

Roughly the southwest half of Section 36, the western half of Section 19, and a small area in the western portion of Section 30 are within Inventoried Roadless Area South Mount Baker #6041. Old growth forest comprises the majority of sections 30 and 31, approximately one third of Section 36, and a small amount of Section 19. Riparian Reserves exist in all sections of this lease site.

WAOR 056027

Numerous roads are found in this lease area. NFD 1127 road crosses the center of section 11 from N to S. NFD 1124 provides access to the SW quarter of Section 11 and the NW of section 13. NFD 1120 crosses Section 13 and the western portion of 24. NFD 1124, 1127, and 1122 cross portions of Section 14. NFD 11/Baker Lake Road crosses through sections 14 and 24 on a NE-SW direction. NFD 118 travels across the SE portion of Section 24. Little Sandy Creek originates in the SE quarter of Section 11. Sandy creek is found in the SW quarter of Section 13, and crosses through the northern half of Section 24.

A small portion along the central northern edge of Section 11 of this lease site is contained within an Inventoried Roadless Area South Mount Baker #6041. Old growth forests comprise approximately two thirds of Section 24, half of sections 13 and 14, and one third of Section 11. Riparian Reserves exist in all sections.

WAOR 056028

Dillard creek crosses Section 15. Sandy Creek crosses through Section 10 and the northern half of Section 23. Sulphur and Rocky creeks pass through Section 22. NFD 13 traverses the western portion of Section 15 and the NW quarter of

Section 22. NFD 12 crosses Section 22 and the SE quarter of Section 23. Additional unnamed roads forest roads are found in sections 15 and 22. A gravel pit is in the SESE of Section 22 and a quarry in the SW of Section 23.

Roughly half of Section 10 and a small portion of on the west side of Section 15 are within Inventoried Roadless Area South Mount Baker #6041. Old growth forests comprise approximately one third of sections 15 and 23, and small portions of sections 10 and 22. Riparian Reserves exist through much of sections 10, 15 and 22, and to a lesser degree in Section 23.

WAOR 056029

NFD 13 road transverses the southern portion of Section 16 and the north east area of Section 17. NFD road 12 crosses the SW quarter of Section 20 and Section 21. Additional unnamed roads provide access to all sections in this lease area. Sulphur Creek cross potions of section 16, 17 and 21.

Roughly the north half of Section 16, the northeast corner of Section 17, and nearly all of sections 20 and 21 are within Inventoried Roadless Area South Mount Baker #6041. Areas not within the roadless area are mostly designated as old growth forest and Riparian Reserves.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on existing land uses, including existing recreational uses and would not conflict with the Mt. Baker Forest Plan or the Northwest Forest Plan.

Alternative B (Proposed Action)

The Proposed Action would not cause any direct impacts on land use or recreation; however, the anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. It is expected that issuing all of the leases in this area would result in two binary power plants at capacities of 30 and 20 megawatts. A 30 megawatt plant is estimated to result in 15 acres of land disturbance, and a 20 megawatt plant result in 10 acres of land disturbance for a total disturbance of 25 acres. Impacts on land use and dispersed recreation associated with geothermal plant development are further discussed in Section 4 of the PEIS, *Land Use, Recreation, and Special Designations*.

Existing Forest Service roads would be used to access these sites. The Proposed Action would be consistent with the Mt. Baker Forest Plan, the Northwest Forest Plan provided that stipulations for relevant land allocations are followed.

Impacts on Late-Successional Reserves

Anticipated geothermal exploration and development activities likely to follow leasing have the potential to impact old growth forests in Late-Successional

Reserves. The Standards and Guidelines in the NWFP for Late-Successional Reserves require that the Mount Baker-Snoqualmie NF assess the impacts of proposed mining actions, and that the NF include in mineral activity permits appropriate stipulations (e.g., seasonal or other restrictions) related to all phases of mineral activity. The guiding principle is to design mitigation measures that minimize detrimental effects to late-successional habitat. These mitigation measures would reduce impacts on Late-Successional Reserves.

Impacts on Inventoried Roadless Areas

Portions of lease sites WAOR 056025, 056058, and 052069 are within Inventoried Roadless Area South Mount Baker #6041. Development in these areas would be consistent with this designation as long as no new roads are constructed to access the sites. Lease stipulations would include a prohibition on road construction or reconstruction. Geothermal development in Inventoried Roadless Areas would be limited to areas directly adjacent to existing roads. Impacts on Inventoried Roadless Areas would be limited to areas directly adjacent to existing roads.

Impacts on Riparian Reserves

Riparian Reserves exist throughout all lease sites. Riparian Reserves would have No Surface Occupancy stipulations associated with them in any leases issued that contain such reserves; therefore, Riparian Reserves would not be impacted.

Impacts on Sulphur Creek Botanical Area (8C)

The Forest Plan recommends denial of application for leasable minerals within these the Sulphur Creek Botanical Area (8C), and withdrawal of this area from pending lease applications where they have not been previously withdrawn.

Potential conflicts with other wildlife management areas are discussed further in Section 17.3.9 *Fish and Wildlife*.

17.3.3 GEOLOGIC RESOURCES AND SEISMICITY

Setting

The pending lease sites lie within the Pacific Mountain System portion of the Pacific geological province, which extends from southern California through the Kenai Fjords of Alaska. The Pacific province is one of the most geologically young and tectonically active regions in North America. The region straddles the boundaries between several tectonic plates, including the Juan de Fuca and North American plates. Where the Juan de Fuca Plate converges with the North American Plate the Cascade subduction zone occurs as the heavier oceanic plates slide underneath the buoyant North American plate (US Geological Survey 2004).

There are some unusual features at the Cascade subduction zone. Where the Juan de Fuca plate sinks beneath the more buoyant North American Plate there is no deep trench, lower seismic activity than expected, and there is evidence of a decline in volcanic activity over the past few million years. The probable explanation lies in a present slower rate of convergence (three to four centimeters per year) (US Geological Survey 2004).

As subduction occurs, high temperatures and pressures allow water molecules locked in minerals of solid rock to escape. The water vapor rises into the pliable mantle above the subducting plate, causing some of the mantle to melt. This newly formed magma rises toward the Earth's surface to erupt, forming a change of volcanoes, known as the Cascade Range, above the subduction zone. The Cascade Range extends from British Columbia to Northern California, roughly parallel to the coastline. Within this region 13 major volcanic centers line in sequence. Initially formed 36 million years ago, the range's major peaks date back to the Pleistocene (US Geological Survey 2004).

The North Cascade Range in Washington State is part of the American Cordillera, a mighty mountain chain stretching more than 12,000 miles from Tierra del Fuego to the Alaskan Peninsula. Although only a small part of the Cordillera, mile for mile, the North Cascade Range is steeper and wetter than most other ranges in the conterminous United States. Rocks of the North Cascades record at least 400 million years of Earth history. The range is a geologic mosaic made up of volcanic island arcs, deep ocean sediments, basaltic ocean floor, parts of old continents, submarine fans, and even pieces of the deep subcrustal mantle of the earth. The disparate pieces of the North Cascade mosaic were born far from one another but subsequently drifted together, carried along by the ever-moving conveyer belt of tectonic plates that make up the Earth's outer shell (US Geological Survey 2004).

All the lease sites lie within approximately ten miles of the summit of Mount Baker. Mount Baker is an isolated stratovolcano. It is the northernmost of the Cascade volcanoes in the United State and second to Mt. Rainier in extent of glaciation. The volcano has been very active over the last ten thousand years, erupting 13 times in recorded history in addition to the occurrence of multiple lava and mud flows (University of North Dakota 2008). Portions of the lease areas lie between the southeastern flank of the volcano and Baker Lake within regions identified in a 1995 US Geological Survey report as areas susceptible to volcano-related hazards, including inundation by cohesive debris flows. Sections closer to the summit fall within a pyroclastic flowage hazard zone, and cold be affected by pyroclastic flows and surges, lava flows, and ballistic debris from future eruptions (US Geological Survey 1995).

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on geological resources, and would not put any people or structures at risk from seismic-related events.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impacts on geological resources or put people or structures at risk from seismic events; however, anticipated actions following leasing could have impacts on these resources and result in risks related to seismicity through inducing seismic events from injection into the geothermal reservoir, increased human presence on the site, and construction of facilities, infrastructure and transmission lines.

Prior to construction of any facilities or infrastructure, geotechnical investigations would need to be conducted to ensure that any construction can withstand strong seismic events, and proper evacuation plans would need to be in place incase of a seismic or eruption event.

17.3.4 Energy and Minerals

Setting

Energy

The electric provider in Whatcom County is Puget Sound Energy. Puget Sound Energy partners with the Public Utility District #1 of Whatcom County, a community-based water and electric utility (Public Utility District of Whatcom County 2005). Approximately one-third of the electricity Puget Sound Energy customers use comes from the utility's own power plants. Together, these plants have more than 2,400 megawatts of power-generating capacity. Puget Sound Energy purchases the rest of its power supply, mostly under long-term contracts, from a variety of other utilities, independent power producers, and energy marketers across the western United States and Canada (Puget Sound Energy 2008).

Low-cost hydropower accounts for the single largest share of Puget Sound Energy's power portfolio. The utility owns and operates three hydropower projects, and purchases additional hydroelectric power from central Washington public utility districts. Additional electricity is generated from four coal and gas fired power plants and two wind farms (Puget Sound Energy 2008).

The Washington Renewable Portfolio Standard Program requires investor-owned utilities to obtain 15 percent of the power supplied to customers to be generated from renewable resources by 2015; Puget Sound Energy is in compliance with this regulation. In addition, a 2002 Washington state law requires all electric utilities in the state to offer their customers the option of purchasing green power. Puget Sound Energy fulfills this measure with the

Green Power Program. Puget Sound Energy's Green Power Program currently has over 19,500 participants, including over 500 businesses (Puget Sound Energy 2008).

Locatable Minerals

The Mt. Baker-Snoqualmie NF has a long history of mining, dating back to the late 1800's. Locatable minerals occurring in the Forest include, but are not limited to, copper, gold, molybdenum, tungsten, olivene, chromite, nickel, zinc, silver, and lead. There are approximately 4,000 mining claims currently in the Forest, the majority of these being located in the Middle Fork Snoqualmie, Sunset-Silver Creek, Vesper Peak, Silverton, Sultan, Darrington, Sauk River, Lone Jack and Twin Sisters areas. A total of 148,187 acres within the Forest have a moderate to high potential for development of locatable minerals (US Forest Service 1990).

Leasable Minerals

Only 18,225 acres in the Forest are classified as prospectively valuable for oil and gas resources. Oil and gas are not thought to exist on the Forest in commercial quantities, but only limited surveys have occurred.

For geothermal resources, a total of 76 geothermal lease applications have been received. Limited exploratory drilling had been conducted, however, the majority of the Forest (1,222,812 acres) has been classified "prospectively valuable" for geothermal energy. NFS land has 14 identified hot or mineral springs identified as having direct utilization potential (Bloomquist 1985). Areas identified as having indirect, electrical generation potential include the Sulphur Creek Hot Springs and Mt. Baker where the current pending lease application sites are located (US Forest Service 1990).

Saleable Minerals

Saleable minerals have been identified in the lease area. Two gravel pits are located in sections 22 and 31, and three quarries are located in sections 14, 23, and 30. The future demand for these materials is likely to reflect the level of road building and maintenance needed in conjunction with timber harvest activities. The demand for county and State highway construction is significant locally, but highly variable in the long term (US Forest Service 1990).

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on energy and mineral resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on energy or mineral resources; however, anticipated future actions following leasing would potentially result in such impacts. One 20 megawatt and one 30 megawatt plant are proposed for development in the lease area for total of 50 megawatts. Details of impacts on energy and minerals are discussed for a standard 50 MW plant in Section 4 of the PEIS, *Energy and Minerals*. Similar impacts are anticipated at the lease sites. This impact would allow existing geothermal resources in the area to be utilized, and would contribute a renewable source of energy to the local and regional power grid. The Proposed Action could potentially contribute to State efforts to meet the RPS as discussed in Section 17.1 of this analysis.

17.3.5 SOILS

Setting

Soils information was provided by the Mount Baker NF through a Geographical Information Systems overlay of soils data with the lease sites. Multiple soil types exist within each of the lease sites, including:

- Ash and cinders;
- Colluvium;
- Colluviated till;
- Eroded glacial materials;
- Glacial till;
- Glacial drift;
- Organics;
- Residium;
- Rock outcrop; and
- Talus slopes (US Forest Service 2008).

There are no prime or unique farmlands within the lease sites.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on soils.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on soils; however, anticipated future actions following leasing would potentially result in impacts on erosion and compaction associated with ground disturbance from the geothermal exploration and development process.

Prior to construction of any facilities or infrastructure, geotechnical investigations would need to be conducted to ensure that any construction be situated on stable soils, and that erosion-prevention measures be implemented in accordance with permitting requirements.

17.3.6 WATER RESOURCES

Setting

Surface Water

Surface water in Washington State is governed by the Washington State Department of Ecology. The lease sites lie within the Skagit River region and the Upper Skagit Watershed.

The major surface water feature near the lease sites is Baker Lake. Baker Lake lies approximately half a mile east of the lease area and is drained by Baker River. In addition, glacial run-off from Mt. Baker is the source of several creeks that traverse the lease sites and drain to Baker Lake. In addition to several unnamed creeks, the following named creeks are within the lease sites:

- Morovitz (WAOR 056025 - Sections 19, 30, 31)
- Park (WAOR 056025 - Sections 31, 36)
- Little Park (WAOR 056025 - Section 31)
- Sulphur (WAOR 056029 - Section 21; WAOR 056028 - Section 22)
- Rocky (WAOR 056029 - Section 21; WAOR 056028 - Section 22)
- Dillard (WAOR 056027 - Section 13; WAOR 056027 - Section 15; WAOR 056029 - Section 16)
- Sandy (WAOR 056028 - Sections 10, 23; WAOR 056027 – Sections 11, 13, 24)
- Little Sandy (WAOR 056027 - Section 11)

Two small ponds exist in Section 31 of WAOR 056025, one of which is on Morovitz Creek. A third pond is found in Section 24 of WAOR 056027. There are no springs within any of the lease sites, although Baker Hot Spring is located immediately east of the southern portion of Section 19.

None of the above-mentioned creeks were classified as impaired in the 2002-2004 Water Quality Assessment for Washington (Washington Department of Ecology 2004).

Ground Water

The lease site is located to the east of the Puget Sound Lowland portion of the Puget-Willamette Trough regional aquifer system, an extensive system of aquifers and confining units that may locally be discontinuous but function hydrologically as a single aquifer system on a regional scale The Trough extends southward from near the Canadian border to central Oregon. In the Puget Sound lowland, unconsolidated-deposit aquifers consist chiefly of glacial deposits that are as much as 3,000 feet thick near Seattle. Sand and gravel that were deposited during the last period of glaciation compose the most productive aquifers in the lowland and generally form the upper 200 to 300 feet of the unconsolidated deposits. At depth, sand and gravel deposits typically are discontinuous lenses that can be present as much as 2,000 feet below the land surface (US Geological Survey 1994).

The section of the aquifer in and around the lease sites is in undifferentiated volcanic and sedimentary rocks from the Pliocene era and younger, including beds of volcanic ash and tuff, silicic volcanic rocks, and semiconsolidated to consolidated sedimentary rock that contain small to large quantities of volcanic material. These rocks are complexly interbedded, and their permeability is extremely variable. The permeability of the various rocks that compose the aquifers is extremely variable. Interflow zones and faults in basaltic lava flows; fractures in tuffaceous, welded silicic volcanic rocks; and interstices in coarse ash, sand, and gravel mostly yield less than 100 gallons per minute of water to wells. Interbedded almost impermeable rocks may retard the downward movement of groundwater and create perched water table conditions in some areas (US Geological Survey 1994).

Although usually much less permeable at depth because of compaction, lenses of sand and gravel can yield large volumes of water to wells. Even though well yields vary greatly, yields from sand and gravel aquifers commonly exceed 2,000 gallons per minute. Some of the open spaces initially formed during cooling or subsequently formed during folding have been filled with secondary clay minerals, calcite, silica, or unconsolidated alluvial deposits emplaced by streams or in lakes. Except where such fill materials are coarse grained, these secondary deposits tend to markedly decrease the permeability of Miocene basaltic-rock aquifers. Miocene basaltic rock aquifer permeability is extremely variable. Maximum specific-capacity values are approximately 3,000 gallons per minute per foot of drawdown. Some interbeds of unconsolidated deposits that contain water under unconfined and confined conditions can yield as much as 100 gallons per minute (US Geological Survey 1994).

Discharge from the aquifer occurs via evapotranspiration, leakage to adjacent aquifers, withdrawals from wells, movement of water to surface-water bodies, and discharge from springs. In the Puget Lowland region most groundwater discharges from springs and seeps to streams that drain the lowland. Large springs discharge from 1,000 to 20,000 gallons per minute from some unconsolidated deposits. Ground water quality is generally fresh and chemically suitable for most uses; sparse settlement in the area has prevented much groundwater contamination. Public, domestic and commercial, and agricultural uses are the main uses of ground water in this area (US Geological Survey 1994).

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on water resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on water resources; however, anticipated future actions would potentially result in such impacts, as described below.

Water Quality

Typical impacts on water quality from geothermal development are described in Chapter 4 of the PEIS under Water Resources. Geothermal waters could introduce contaminants into the drinking water aquifer. Subsequent project-specific environmental reviews and permits would ensure that drilling procedures, including the installation of well casings and sealings, are conducted to current Oregon well construction standards. Lease stipulations and best management practices addressing stormwater are included in Chapter 2 and Appendix D, respectively, of the PEIS and would reduce impacts on surface water quality.

Water Quantity

Indirect use geothermal projects require large amounts of water during all phases of a project from exploration through reclamation and abandonment; therefore, anticipated future actions following leasing could result in impacts on the surface water and ground water quantities. Both groundwater and surface waters are abundant in the lease area, and no impacts on existing water resources are expected.

The lease sites are separated from the North Cascades National Park by a drop in topography and a distance of 1.9 miles at the closest point, which is the northeast corner of lease site WAOR 056025. The rest of the lease sites (WAOR 056029, 056028, 056027) are separated from the National Park by Baker Lake and a greater distance than 1.9 miles. The nearby National Park does not have any recorded thermal features. A hydrological connection to aquifers and geothermal reservoirs within the National Park is considered to be unlikely. There would be no effect on thermal features within National Parks.

17.3.7 Air Quality and Atmospheric Values

Setting

The lease area is located in Whatcom County, an area with air quality status of Unclassified. Due to the remote location of the lease sites, air quality is considered to be good.

The lease site is located in the Cascade Mountain range in Washington. Condensation occurs as the air moves inland over the cooler land and rises along the windward slopes of the mountains. This results in a wet season beginning in October, reaching a peak in winter, and gradually decreasing in the spring.

The closest weather monitoring station to the lease site is at the Upper Baker Dam, Washington, approximately two miles south of the least area. Average maximum temperatures at Upper Baker Dam range from 38.8 degrees Fahrenheit in January, to 74.6 in August, with average minimum temperatures ranging from 28.5 degrees Fahrenheit in January, to 51.3 in August. Average annual precipitation at the Upper Baker Dam station is 99.67 inches (Western Regional Climate Center 2008).

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on air quality and atmospheric values.

Alternative B (Proposed Action)

The Proposed Action alternative would not have any direct impacts on air quality or atmospheric values; however, anticipated future actions following leasing may result in such impacts, the nature of which are discussed in Section 4.8 of this PEIS. Anticipated future actions would not result in violations of ambient air quality standards given the Unclassified status of the county and the good level of air quality.

17.3.8 VEGETATION

Setting

The pending lease sites are located within the western hemlock (*Tsuga heterophylla*) zone of the Northern Cascades Physiographic Province (Franklin and Dyrness 1988). Mt. Baker (elevation 10,778 feet above mean sea level) and other high mountain peaks rise up from the lease area on the north and west. The lease area is on a southeast slope of Mt. Baker. Along these slopes, vegetation transitions to higher elevation assemblages including the Pacific silver fir (*Abies amabilis*), mountain hemlock (*Tsuga mertensiana*), and parkland zones (Forest Service 2002).

Events of both natural and human origin have modified forest stands in the lease area. Natural disturbance events include wind storms, wildfire, and avalanches. Human disturbance of vegetation has occurred through timber management activities, fire, and recreational use. The lease area is a mosaic of forest stand ages, containing both old-growth and second growth coniferous forest. The area is federally managed as NFS lands, and timber harvest is currently restricted.

The forest in the pending lease is predominately of the old-growth and late successional forest types (Federal Energy Regulatory Commission 2006). The forest types include coniferous, mixed, and deciduous forests.

Late-Successional Reserves

In 1994 the NWFP designated a network of Late-Successional Reserves with the object of protecting and enhancing conditions of late-successional and old-growth forest ecosystems and the species that depend on this habitat (US Forest Service 1994b). The Baker Late-Successional Reserve is about 82,100 acres and includes the entire lease area.

Coniferous and Mixed Coniferous/Deciduous Forest

Coniferous forests capable of exhibiting great biomass and longevity dominate the lease area (US Forest Service 2002). Old-growth coniferous forests are characterized by very old and large overstory trees. Old growth forests have multiple structural attributes that make them high value areas for wildlife, including variation in tree size and spacing, broken and deformed tops, multiple canopy layers, canopy openings, variation and patchiness of understory composition, and large-diameter standing dead and downed trees. This complex habitat supports a large number of plant and animal species, some of which are found only in late seral forests. Mature forests typically exhibit some, but not all, of the components of old-growth forests. These forests make up much of the areas proposed for leasing.

Deciduous Forest and Shrub Habitats

Deciduous forest stands in the lease area are found in areas with relatively recent and/or frequent ground disturbance, such as timber harvest, landslide areas, avalanche chutes, and riparian zones of low to moderate gradient streams and rivers. Red alder (*Alnus rubra*) is the dominant species in areas with disturbed soils within the western hemlock zone; it is also common within riparian zones. Big-leaf maple (*Acer macrophyllum*) is common in riparian zones and in openings in coniferous forest. Black cottonwood (*Populus balsamifera spp. trichocarpa*) is the dominant overstory species along riparian zones with moderately to well-developed floodplains, but is not found in the lease area. Within areas of frequent disturbance, such as avalanche chutes and riparian zones, deciduous shrub communities may persist; these are typically dominated by willows (*Salix species*), vine maple (*Acer circinatum*), and salmonberry (*Rubus spectabilis*) (Federal Energy Regulatory Commission 2006).

Deciduous forest stands along riparian zones can provide locally unique wildlife habitat when certain structural features are present. Locally unique features can include variation and patchiness of understory vegetation, snags and downed logs, seasonal canopy cover, and stream shading. This habitat is less common in the areas proposed for leasing.

Riparian Habitats

Riparian habitats are located at the interface between terrestrial habitats and aquatic environments. Deciduous forest and shrub habitats are characteristic along active channels of low gradient waterways with well-developed floodplains. Riparian zones narrow with increasing stream gradient on the north and west sides of the lease area, leading to stands of mixed coniferous and deciduous species. Coniferous tree species dominate the overstory along narrow higher gradient streams, which are waterways most common in the lease area. On NFS lands in the lease area, an estimated 10 percent of the riparian area has been disturbed by timber harvest (Federal Energy Regulatory Commission 2006).

Riparian Reserves

On federal lands, riparian reserves are designated to protect water quality; timber harvest is prohibited and ground disturbances are not allowed. The reserve's width is based on the presence of fish and whether the stream is permanent or intermittent (see Table 17.3-1 below). Riparian reserve widths are determined by the average maximum height of the tallest trees in the area, "site-potential tree height", or a minimum width requirement.

Table 17.3-1
Federal Riparian Reserve Width Requirements
(Each side of the Stream)

Stream Class	Riparian Reserve Width
Fish Bearing	Average height of 2 site potential trees or 300 feet
Permanent Non-Fish Bearing	Average height of 1 site potential tree or 150 feet
Intermittent	Average height of 1 site potential tree or 100 feet

Wetlands and Open Water Habitats

Wetlands in the vicinity of the lease area include forested, scrub, emergent, and open water habitats of small ponds; however, there are no documented wetlands within the lease sites themselves (US Fish and Wildlife Service 2008a). The most common tree species associated with forested wetlands are red alder, black cottonwood, and western red cedar. Shrub wetlands in the basin are characterized by various willow species, salmonberry, vine maple, and spiraea (*Spiraea douglasii*). Emergent wetlands in the basin support a variety of sedges, forbs, and grasses, including the common invasive species, such as reed canarygrass (*Phalaris arundinacea*). Wetlands provide valuable plant, fish, and wildlife habitat, and are also valued for their hydrologic functions. The Forest Service manages the land adjacent to streams, lakes, reservoirs, and wetlands as Riparian Reserves, per the direction of the NWFP (US Forest Service 1994b).

Invasive and Non-Native Plant Species

Invasive and non-native plant species are known to occur in the lease area and vicinity. These species can be aggressive, out-competing native plant species, reducing the value of wildlife habitat, and affecting waterways and aquatic habitats. Washington Weed Law (Chapter 17.10 RCW) requires that noxious weeds be controlled to limit adverse economic effects on agricultural, natural, and human resources of the state. Noxious weeds are plants that, when established, are highly destructive, competitive, or difficult to control by cultural or chemical practices. The State Noxious Weed Control Board updates its list of noxious weeds annually and categorizes the species into three classes. The State Board coordinates noxious weed control activities throughout the state via County Weed Districts and County Noxious Weed Control Boards. Management goals for noxious weed species may range from complete eradication to containment of the species within a currently infested area. Multiple invasive plant species are documented in the Baker Lake area and are expected to occur within the lease area (US Forest Service 2004).

Impacts

Potential impacts on vegetation and important habitats could occur if reasonably foreseeable future actions were to:

- Affect a plant species, habitat, or natural community recognized for ecological, scientific, recreational, or commercial importance;
- Affect a species, habitat, or natural community that is specifically recognized as biologically significant in local, state, or federal policies, statutes or regulations;
- Establish or increase noxious weed populations;
- Destroy or extensively alter habitats or vegetation communities in such a way that would render them unfavorable to native species; or
- Conflict with FS management strategies.

Alternative A (No Action)

The No Action alternative would have no impact on vegetation and important habitats.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on vegetation; however, anticipated future actions following leasing would potentially result in such impacts through an estimated disturbance of approximately 25 acres. Potential impacts associated with future exploration, drilling operations and development, utilization, and reclamation and abandonment would include the following:

- Habitat disturbance – Site clearing, well drilling, construction of access roads and geothermal facilities, as well as maintenance and operational activities would disturb timber and scrub habitat, increase risk of invasive species, and alter water and seed dispersion, as well as wildlife use, which can further affect vegetation communities.

- Direct Removal and Injury – Trees and other vegetation would be cleared for roadways, vehicle staging, buildings, pipelines, and transmission lines. Activities could result in loss of soil, loss of seed bank in soil, deposition of dust and. Maintenance around project components, such as drill pads, buildings, pipelines, or other facilities would involve mowing, herbicide treatment, and other mechanical or chemical means of removal and control. This would result in a net loss of important habitats and communities in the lease area.
- Invasive Vegetation – Disturbance and access by vehicles and human foot traffic may expose areas to colonization by invasive and non-native species, making it more difficult for endemic species to reestablish in disturbed areas and threatening the continued existence of endemic species (Bureau of Land Management 2007).
- Fire – Increased vehicular and human traffic, operation of equipment, the use of drilling muds, and the extraction of geothermal fluids can increase the risk of fires. Vehicles, electrical lines, and cigarette smoking can all result in accidental fires. Fires destroy valuable timber and forest vegetation and can aid in the establishment of invasive species.
- Erosion – Site clearing, grading, construction of access roads, containment basins, site runoff and vehicle and human foot traffic cause erosion. The effects of erosion include the removal of top soil, loss of seed bank, loss of native vegetation, the establishment of invasive species, the sedimentation of streams, and flooding (which can directly result in affects to riparian vegetation and riparian habitats).
- Exposure to Contaminants – Vehicle fuel, hydraulic fluid, solvents, cleaners, and geothermal fluids can all be harmful to vegetation and important habitats such as riparian areas. Accidental spills can contaminate soils and water and directly harm vegetation. Licensed herbicide use would likely be employed to control vegetation around geothermal facilities and support structures. Spills of herbicides or acute exposure to herbicides can have adverse effects on non-target vegetation.

Old Growth and Late Successional Reserves

Old growth, including Late-Successional Reserves, is present throughout much of the lease area. The issuance of the pending noncompetitive lease applications has the potential to impact old growth forests in Late-Successional Reserves. Geothermal development of the lease sites would result in the removal of forest, and may include old-growth and late-successional reserves. The Standards and Guidelines in the NWFP for Late-Successional Reserves require that the Mount Baker-Snoqualmie NF assess the impacts of proposed mining actions, and that the NF include in mineral activity permits appropriate stipulations (e.g., seasonal or other restrictions) related to all phases of mineral activity. The guiding principle is to design mitigation measures that minimize detrimental effects to late-successional habitat. These mitigation measures would reduce impacts on old growth forests in Late-Successional Reserves. Specific impacts affecting old-growth forest are discussed further in Volume I of the PEIS, Section 4.9 *Vegetation and Important Habitats*.

Riparian and Wetland Habitats
Riparian habitats are found in several locations within the lease area. Riparian habitats are protected as riparian reserves under the NWFP. Stipulations and best management practices exist to limit the level and intensity of potential impacts that may result from development activities within NFS lands, including limitations on surface occupancy and tree and vegetation removal with buffer zones; however, potential impacts on riparian habitats would still exist, including sedimentation, runoff, erosion, and effects to water quality and hydrology. Refer to Section 4.9 *Vegetation and Important Habitats* of Volume I of the PEIS for a more detailed discussion of the potential impacts on riparian habitats resulting from each stage of a geothermal project.

Wetland habitats are not known to occur in the lease area; however, conditions are dynamic and may change over time. Impacts that could occur to wetlands include dewatering, changes in hydrology, disturbance, and removal. Impacts on wetlands are regulated under the River and Harbors Act and Section 404 of the Clean Water Act. Permitting from the U.S. Army Corps of Engineers (Corp) will be required if future development at the site will have any impact on wetlands under Corps' jurisdiction. In addition, Executive Order 11990, "Protection of Wetlands," requires all federal agencies to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. A more complete discussion of the potential impacts on wetlands resulting from geothermal activities is can be found in Section 4.9 of the PEIS.

17.3.9 Fish and Wildlife

Setting

Fisheries
The following section describes the existing aquatic habitat and fish species occurring in Baker Lake and the lease area. Additional information on federally listed threatened and endangered species is provided in Section 3.11 of Volume I of the PEIS, *Federally Listed Threatened and Endangered Species and Essential Fish Habitat*.

The proposed lease area is within the Baker Lake subbasin which includes Baker Lake and its tributaries. Baker Lake is approximately 9 miles long and covers 4,980 surface acres when full. Several streams run through the lease area, including Sandy and Dillard creeks. Past timber harvest has limited the amount of large woody debris in some of the creeks (Forest Service 2002) in the Baker Lake Basin.

Resident and anadromous fish have access to portions of approximately 30 tributaries to Baker Lake, including those in the lease area; however, steep gradients limit anadromous fish use. The lower reaches of these streams may also be suitable for rainbow and cutthroat trout and resident native char (Federal Energy Regulatory Commission 2006).

Anadromous Fish Species

The following six species of anadromous salmonids occur in Baker Lake and may occur in the lease area: sockeye (*Oncorhynchus nerka*), coho (*O. kisutch*), Chinook (*O. tshawytscha)*, steelhead (*O. mykiss*), native char (*Salvelinus* sp.), and coastal cutthroat trout (*O. clarki*). It is unknown whether anadromous native char spawn in the Baker River watershed (Federal Energy Regulatory Commission 2006).

Fish counts conducted by adult trapping from 1926 through 2003 indicate coho and sockeye salmon were the most abundant salmon stocks returning to the Baker Lake area with the remaining species comprising only about 7 percent (Federal Energy Regulatory Commission 2006).

Resident Fish Species

Nine species of resident fish are expected to occur in Baker Lake. These include four species of native game fish and five species of native non-game fish (Table 17.3-2). The abundance of many of these fish is not known.

Table 17.3-2
Resident Fish Species Confirmed Present in Baker Lake and Potentially Occurring in the Lease Area

Common Name	Scientific Name	Status
Native char	*Salvelinus* spp.	Native, common
Rainbow trout	*Oncorhynchus mykiss*	Native, common
Coastal cutthroat trout	*Oncorhynchus clarki*	Native, common
Kokanee (sockeye salmon)	*Oncorhynchus nerka*	Native, common
Three-spine stickleback	*Gasterosteus aculeatus*	Native non-game fish, uncommon
Torrent sculpin	*Cottus rhotheus*	Native non-game fish, common
Prickly sculpin	*Cottus asper*	Native non-game fish, common
Coastrange sculpin	*Cottus aleuticus*	Native non-game fish, common
Largescale sucker	*Catostomus macrocheilus*	Native non-game fish, common

Puget Sound Energy is required to provide upstream and downstream fish passage and operate spawning beaches for sockeye production as part of its existing license to operate hydroelectric facilities on the Baker River. In addition to these programs, Puget Sound Energy also operates the Sulphur Creek hatchery facility, where voluntary production and rearing programs are conducted (Federal Energy Regulatory Commission 2006).

Wildlife

This section describes the occurrence and distribution of wildlife species in the lease area and vicinity. The Baker River basin supports over 164 species of birds, 60 species of mammals, and numerous additional species of amphibians, reptiles, mollusks, and insects (Puget 2002).

Reptiles and Amphibians

Nineteen species of reptiles and amphibians are known or suspected to occur in the project vicinity (Puget 2002). Reptiles likely to inhabit the area include the western terrestrial garter snake (*Thamnophis elegans*), common garter snake (*Thamnophis sirtalis*), and northern alligator lizard (*Elgaria coerulea*). Surveys of amphibian habitats were conducted in 2001 and 2002 for the Baker River Project (Hamer Environmental 2002). Field survey methods were designed to sample suitable habitats in and near the project area for five species of amphibians with special federal or state management status: Cascades frog (*Rana cascadae*), Oregon spotted frog (*Rana pretiosa*), northern redlegged frog (*Rana aurora*), tailed frog (*Ascaphus truei*), and western toad (*Bufo boreas*). A total of 11 species of amphibians were documented as part of the Baker River Project surveys including Pacific giant salamander (*Dicamptodon tenebrosus*), northwestern salamander (*Ambystoma gracile*), long-toed salamander (*Ambystoma macrodactylum*), northern rough-skinned newt (*Taricha granulosa*), western red-backed salamander (*Plethodon vehiculum*), tailed frog, western toad, Pacific chorus frog (*Pseudacris regilla*), northern red-legged frog, Cascades frog, and the non-native bullfrog (*Rana catesbeiana*).

Birds

Over 164 species of birds are known or are potentially present in the Baker River Watershed (Puget 2002). Species include waterfowl, shorebirds, waterbirds, game birds, raptors, songbirds, and other birds. Bird species closely associated with old-growth and late successional forests found in portions of the lease area include the northern spotted owl (*Strix occidentalis* spp. *caurina*) and marbled murrelet, both federally-listed species.

Species closely associated with deciduous forest and shrub habitats in the lease area include yellow warbler (*Dendroica petechia*), MacGillivray's warbler (*Oporornis tolmiei*), black-capped chickadee (*Parus atricapillus*), red-eyed vireo (*Vireo olivaceous*), olive-sided flycatcher (*Contopus cooperi*), and ruffed grouse (*Bonasa umbellatus*).

Mammals

Large mammals in the lease area and surrounding vicinity include blacktailed deer (*Odocoileus hemionus columbianus*), elk (*Cervus elaphus*), black bear (*Euarctos americanus*), mountain lion (*Felis concolor*), and mountain goat (*Oreamnos americanus*). Both grizzly bear (*Ursus arctos*) and gray wolves (*Canis lupus*) have been observed in the Baker River basin. Canada lynx (*Lynx canadensis*) are present east of the Cascade crest, but are not known to occur in the Baker River basin. Wolverines (*Gulo gulo luteus*) have been documented in the region and strongly suspected to be resident animals in the Baker River basin and the lease area (Gay 2008).

Furbearer species in the lease area include river otter (*Enhydra lutra*), beaver (*Castor canadensis*), raccoon (*Procyon lotor*), American marten, and coyote (*Canis latrans*). Common small mammals in the project vicinity are Townsend chipmunk (*Eutamias townsendi*), Trowbridge shrew (*Sorex trowbridgei*), deer mouse (*Peromyscus maniculatus*), snowshoe hare (*Lepus americanus*), Douglas squirrel (*Tamiasciurus douglasi*), and northern flying squirrel (*Glaucomys sabrinus*). Bats that may inhabit the vicinity include little brown myotis (*Myotis lucifugus*), long-eared myotis (*Myotis evotis*), silver-haired bat (*Lasionycteris noctivagans*), and Yuma myotis (*Myotis yumanensis*) (Federal Energy Regulatory Commission 2006).

Impacts

Potential impacts on Fish and Wildlife could occur if reasonably foreseeable future actions were to:

- Adversely affect a population by substantially reducing its numbers, causing a fish or wildlife population to drop below self sustaining levels or causing a substantial loss or disturbance to habitat, such effects could include vehicle impacts and crushing, increased predation, habitat fragmentation, or loss of seasonal habitat;
- Have a substantial adverse impact on nesting migratory birds, including raptors, as protected under the Migratory Bird Treaty Act;
- Interfere with the movement of any resident or migratory fish or wildlife species, or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites; or
- Conflict with the wildlife management strategies of the FS.

Alternative A (No Action)

The No Action alternative would have no impact on fish and wildlife.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on fish and wildlife; however, anticipated future actions following leasing would potentially result in impacts on fish and wildlife from future development of geothermal power plants within the lease area that would disturb approximately 50 acres. Potential impacts that would affect all wildlife would result from:

- Habitat disturbance – The fragmentation of wildlife habitat for species requiring large contiguous tracts, such as elk, mountain lion, and black bear, can be affected by site clearing, well drilling, construction of access roads and geothermal facilities, as well as maintenance and operational activities. These activities could cause: disruption of breeding, foraging and migration, as well as mortality and injury of wildlife,
- Invasive Vegetation – Invasive species can affect wildlife by reducing habitat quality and species diversity; and affect foraging and breeding behavior.
- Injury or Mortality – Wildlife could be injured or killed during the clearing of roadways, vehicle staging, building construction, and other activities. Small mammals, reptiles and amphibians are most likely to be affected.
- Erosion and runoff – The effects of erosion include the loss of habitat for terrestrial species, and increased turbidity, which can directly affect the resident salmonid species found in the lease area.
- Fire – Vehicles, electrical lines, and cigarette smoking can all result in accidental fires. During fires wildlife can be killed or injured. After fires wildlife may be forced to move to other habitats, or may be without suitable habitat for important behavioral activities.
- Noise – Construction and operation of geothermal facilities can produce noise far above normal ambient noise levels. Many species are sensitive to increases in noise that may cause disruption of breeding, migration, wintering, foraging, and other behavioral activities.
- Exposure to Contaminants – Vehicle fuel, hydraulic fluid, solvents, cleaners, and geothermal fluids can all be harmful to fish and wildlife. Accidental spills can contaminate soils and water and indirectly harm wildlife. Licensed herbicide use would likely be used to control vegetation around geothermal facilities and support structures. Spills of herbicides or acute exposure to herbicides can have adverse effects on wildlife.

Fish

Fish species in the lease area and in Baker Lake could be affected by several activities. Impacts on fish and aquatic biota from development to the lease area would be linked to impacts on riparian habitats and immediately adjacent upland habitat. Ground disturbance, vegetation removal, ground water withdrawal, road construction and excavation, installation of structures and other facilities, such as transmission towers or pipelines, and release of water contaminants could affect fish species residing in streams in the project area, such as coho salmon, cutthroat and rainbow trout, as well as resident fish species found downstream in Baker Lake. Changes in hydrology, increased turbidity, changes in water quality (temperature, dissolved oxygen, pollutants, etc), loss of riparian vegetation (an indirect aquatic food source), restriction of fish movement and migration, and changes in predator and human use of the aquatic habitat are all potential impacts associated with development of the lease area. The PEIS provides a more complete analysis of the potential impacts on fish resulting from geothermal activities, as well as impacts on riparian and wetland habitat that could affect fish and other aquatic biota.

Essential Fish Habitat

The Magnuson-Stevens Fisheries Conservation and Management Act or Magnuson-Stevens Act, as amended by the Sustainable Fisheries Act of 1996 (PL 104-267), established procedures designed to identify, conserve, and enhance Essential Fish Habitat for species regulated under a federal fisheries management plan. The Magnuson-Stevens Act defines Essential Fish Habitat as those waters and substrate necessary for fish use in spawning, breeding, feeding, or growth to maturity. The Magnuson-Stevens Act requires federal agencies to consult with the National Marine Fisheries Service regarding activities that may adversely affect Essential Fish Habitat. Essential Fish Habitat consultations are intended to determine whether proposed projects would adversely affect designated Essential Fish Habitat and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to Essential Fish Habitat. The implementing regulations for Magnuson-Stevens Act allow for the integration of NEPA or Endangered Species Act Section 7 reviews with the analysis of proposed project effects on Essential Fish Habitat.

Pursuant to the Magnuson-Stevens Act, the Pacific Fisheries Management Council has designated Essential Fish Habitat for Chinook, coho, and Puget Sound pink salmon. Freshwater Essential Fish Habitat for coho and Chinook salmon includes all streams, lakes, ponds, wetlands, and other water bodies currently or historically accessible to salmon in Washington, Oregon, Idaho, and California. Freshwater Essential Fish Habitat for pink salmon includes all currently or historically accessible waters in the Puget Sound region. The four major components of Essential Fish Habitat for these species consist of (1) spawning and incubation habitat, (2) juvenile rearing habitat, (3) juvenile migration corridors, and (4) adult migration corridors and adult holding habitat.

Essential Fish Habitat potentially affected by geothermal activities at the lease areas may occur in the streams that pass through or are immediately adjacent to the lease areas. Additionally, Baker Lake, which is downstream of the lease area, contains Essential Fish Habitat and could be affected by geothermal activities causing erosion, runoff, and changes in hydrology or water quality of the lake.

Wildlife

Amphibians present in the lease area could be affected by any impacts that affect riparian habitat or water quality. Additionally, activities would result in direct mortality for amphibians and reptiles that would be crushed by equipment or entrapped in underground burrows.

The habitats within the lease area provides habitat for a variety of migratory birds. The FS is required to analyze the impacts of any action on migratory birds, under the Migratory Bird Treaty Act. The likelihood of disturbing nests of such birds is limited primarily to breeding and nesting seasons (spring and summer). Waterfowl, raptors, and small birds that depend on particular forest types as a source of food or cover could be vulnerable to loss of habitat within the lease area. Removing timber and other vegetative cover affects foraging and nesting behavior. The incorporation of stipulations along the lines of the following text, but revised and made more specific by NF wildlife biologists, into any issued leases would reduce the potential for significant impacts on migratory birds:

> Prior to any ground-disturbing activities that may disturb nesting, migratory bird surveys would be conducted to assess the presence and use of forest habitats by migratory birds. To avoid disturbing nesting migratory birds, appropriate measures include (1) keeping a distance between the activity and the nest; (2) maintaining preferably forested (or natural) areas between the activity and around nest trees; and (3) avoiding certain activities during the breeding season.

The Nooksack Elk Herd provides recreational, aesthetic, spiritual, and subsistence values to residents of northwestern Washington. The herd is the smallest in Washington and has decreased in size over the past 15 years. The lease area is located on the eastern edge of the Nooksack herd's range. Foraging habitat may not be a limiting factor to the herd at present, but the availability of forage in the future is a concern. Habitat clearing and human activity associated with geothermal projects could disturb elk, displacing them temporarily or permanently from otherwise suitable foraging habitats in and adjacent to the lease area. Geothermal activities associated with development of the lease sites would also result in increased human activity and potentially increase recreational use of the area, which could directly affect elk populations.

17.3.10 Threatened and Endangered Species and Special Status Species

Setting

This section provides an overview of threatened, endangered, and special status species, and their habitats in the proposed lease area. Special status species are those identified by federal, state, or local agencies as needing additional management considerations or protection. The discussion of special status species is based primarily on analysis conducted over several years for the Baker

River Hydroelectric Project (Federal Energy Regulatory Commission 2006) as well as correspondence with NFS biologists regarding the lease area. Federal species are those protected under the Endangered Species Act and those that are candidates or proposed for listing under the Act. State sensitive species are those considered sensitive by the Washington Division of Fish and Wildlife. Federally and state listed species with record of occurrence in the proposed lease area are discussed below.

Critical Habitat

The Endangered Species Act requires the federal government to designate critical habitat for any species listed under the Act. Critical habitat is any specific area within the geographical area occupied by the species at the time of listing under the Act containing physical or biological features essential to conservation, and those features require special management considerations or protection; as well as those areas outside the geographical area occupied by the species determined essential to conservation.

Critical habitat designations must be based on the best scientific information available, in an open public process, within specific timeframes. Before designating critical habitat, careful consideration must be given to the economic impacts, impacts on national security, and other relevant impacts of specifying any particular area as critical habitat. The Secretary of Commerce may exclude an area from critical habitat if the benefits of exclusion outweigh the benefits of designation, unless excluding the area will result in the extinction of the species concerned.

The Endangered Species Act protects threatened and endangered species in several ways. Under Section 7, all federal agencies must ensure that any actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of a listed species, or destroy or adversely modify its designated critical habitat.

Coho Salmon

Coho salmon from the Baker River are considered a separate stock from Skagit River coho because of their smaller size at maturity, and because they historically had an earlier adult run timing. These fish are present in Baker Lake. Coho spawning generally occurs from October through January. Spawning and rearing habitat for coho salmon is found in both lease sites WAOR 056025 and 056027 (US Forest Service 2008f). Baker River coho juveniles rear in the stream and lake habitats for one to two years. Coho smolts migrate to the ocean from March to August, with peak migration occurring in May and June (National Marine Fisheries Service 2008). Management of coho fisheries in the Baker River system is under the jurisdiction of Washington Department of Fish and Wildlife and Tribal interests. Coho salmon in the Baker River system are included on the Forest Service Regional Forester's Sensitive Animal list. Impacts on coho salmon would be analyzed as part of Essential Fish Habitat and Section 7 consultation with NOAA Fisheries.

Marbled Murrelet

The marbled murrelet was designated as federally threatened in Washington, Oregon, and California on October 1, 1992 (57 FR 45328); it is also a Washington State threatened species. Critical habitat was designated for the species in 1996 (61 FR 26255) and a recovery plan was adopted in 1997 (US Fish and Wildlife Service 1997).

The marbled murrelet is a small seabird that feeds at sea and nests in the canopy of old-growth coniferous forests. The bird prefers large stands (500 acres) over smaller ones (100 acres) and avoids forest stands less than 60 acres (US Fish and Wildlife Service 2008a). Large diameter trees with large diameter limbs, broken tops, and other deformities are used for nest platforms. The breeding season extends from April 1 to September 15. Murrelet pairs have a single offspring and adult murrelets carry food from marine waters, typically small fish, to the nest site; this distance can exceed 50 miles (Mack et al. 2004).

Factors contributing to the decline in marbled murrelet populations include over-fishing of its prey species, entanglement in fishing nets, oil spills, and loss of nesting habitat through timber harvest and development (US Fish and Wildlife Service 2008b). Potential threats to marbled murrelet populations include loss of old-growth forest, disturbance during nesting, nest predation, oil spills, entanglement in gill-nets, and disturbance during foraging (Mack et al. 2004).

Critical habitat was designated for the marbled murrelet to provide suitable nesting habitat, located in proximity to marine foraging habitat, on lands not otherwise protected by existing regulations or land use designation. The entire lease area falls within lands designated as critical habitat for marbled murrelet. Murrelets generally use forest stands in the western hemlock and silver fir vegetation zones located below 3,200 feet elevation. Surveys of the Baker River basin have documented marbled murrelets present during the nesting season, and presumably nesting. Forest Service surveys indicate that the northern half of the Mt. Baker-Snoqualmie National Forest accounts for 50 percent of nesting habitat and 85 percent of murrelet detections on the entire forest (US Forest Service 2002).

Surveys have not been conducted in the area in recent years, and the current status of marbled murrelets in the lease area is unknown. Most suitable marbled murrelet habitat in the Baker River basin is protected by designation as critical habitat or as Late-Successional Reserve, within which timber harvest and development is restricted.

Northern Spotted Owl

The northern spotted owl was federally listed as threatened in Washington, Oregon, and California in July 1990 (55 FR 26114); it is a Washington State endangered species. Factors that contributed to the federal listing were the declining population trends, the loss of suitable forested habitats throughout the species range, and the lack of adequate regulatory mechanisms to protect existing habitat for the species. Critical habitat was designated for the northern spotted owl in 1992 (57 FR 1796). Spotted owls are strongly associated with mature and old-growth forests for nesting, foraging, and roosting. Nesting and roosting occur in a variety of coniferous forest types characterized by moderate to high levels of canopy closure; high density of standing snags; large diameter overstory trees with deformities, such as broken tops and witches' brooms; and abundant coarse woody debris on the forest floor (Courtney et al. 2004).

Critical habitat for spotted owl is found throughout the lease area. The NWFP serves recovery plan functions through specific management requirements, standards, and guidelines. Designated Conservation Area WD-21 was established in 1992 for the protection of northern spotted owls under the Endangered Species Act (US Fish and Wildlife Service 1992). The area encompasses roughly 104,000 acres of NFS lands on the Mt. Baker Ranger District, roughly 29,000 acres not included in the Baker Late-Successional Reserve. The Baker Late-Successional Reserve and Designated Conservation Area WD-21 combined are projected to support 28 pairs of nesting spotted owls (US Forest Service 2002). The Baker Late-Successional Reserve/Designated Conservation Area is expected to be a major contributor to spotted owl recovery as a source of owls dispersing to the north, southeast, south, and east.

The size of old-growth stands is also important to the quality of spotted owl habitat. Throughout the Baker Late-Successional Reserve, most patches of late successional and old-growth forests are greater than 620 acres. Old-growth forest has been fragmented into smaller blocks in the Rocky, Sandy, and Dillard creek drainages passing through the lease area.

Grizzly Bear

The grizzly bear is a federally threatened species. The species is also classified as endangered by the State of Washington. The grizzly bear was listed as federally threatened under the Endangered Species Act in the 48 contiguous states in 1975 (40 FR 31734). The primary causes of population decline are hunting, human disturbance, and habitat alteration.

Grizzlies are omnivores that use a wide range of habitat types across a large home range. Home ranges of males can be 200 to 500 square miles, while those of females are in the range of 50 to 300 square miles (US Fish and Wildlife Service 2008b). Habitat use varies with season, with lower elevation, snow-free areas used in early spring, mid-elevation habitats during summer, and mid- to high-elevation habitats during late summer and fall (US Fish and Wildlife Service

2008b). Presence of roads and humans are negatively correlated with grizzly bear presence.

The most recent grizzly sightings in the project vicinity include an observation of one adult and one young in the Baker River headwaters in 1991 (Federal Energy Regulatory Commission 2006) and a grizzly bear track was recorded in 1989 on the southeast side of Baker Lake, approximately eight miles from the lease sites (Federal Energy Regulatory Commission 2006).

Impacts

Title 16, United States Code, section 1531 *et seq.,* and Title 50, Code of Federal Regulations, part 17.1 *et seq*., designate and provide for protection of threatened and endangered plant and animal species, and their critical habitat. The administering agencies are the US Fish and Wildlife Service and the National Marine Fisheries Service. Consultation pursuant to Section 7 of the Endangered Species Act would be performed prior to any ground-disturbing activity.

Potential impacts on threatened and endangered and special status species could occur if reasonably foreseeable future actions were to:

- Violate the Endangered Species Act, the Migratory Bird Treaty Act, or applicable state laws; or
- Decrease a plant or wildlife species population to below self-sustaining levels.

Alternative A (No Action)

The No Action alternative would have no impact on special status species.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on special status species; however, anticipated future actions following leasing would potentially result in impacts on special status species. Threatened and endangered species (including federal and state listed species and FS and BLM special status species) could be affected as a result of 1) habitat disturbance, 2) the introduction of invasive vegetation, 3) injury or mortality, 4) erosion and runoff, 5) fugitive dust, 6) noise, 7) exposure to contaminants, and 8) interference with behavioral activities.

Because of the regulatory requirements of the Endangered Species Act and various state regulations, and the requirements specified in BLM Manual 6840 Special Status Species Management and other resource-specific regulations and guidelines, stipulations to perform appropriate survey, avoidance, and mitigation measures would be identified and implemented prior to any geothermal activities to avoid adversely affecting any sensitive species or the habitats on which they rely.

17.3.11 CULTURAL RESOURCES

Setting

Cultural resources are past and present expressions of human culture and history in the physical environment and include prehistoric and historic archaeological sites, structures, natural features, and biota that are considered important to a culture, subculture, or community. Cultural resources also include aspects of the physical environment that are a part of traditional lifeways and practices and are associated with community values and institutions.

As in the PEIS, discussions relevant to cultural resources in this document are found in two sections. Traditional cultural resources and traditional cultural properties are addressed in Section 17.3.12, *Tribal Interests and Traditional Cultural Resources*. Cultural resources in this section include the physical remains of prehistoric and historic cultures and activities.

All four leases in Washington are within the Northwest Coast culture region, as described broadly in the Appendix I of the PEIS, near the region's eastern boundary with the Great Plains culture region. Cultural aspects of both regions likely existed within the lease areas. Suttles and Lane (1990) provide an ethnographic overview of the project area within the larger Northwest Coast culture region. The following discussion is based primarily on that overview. Given that the Washington leases are in a more inland portion of the area, cultural aspects specific to that setting are focused upon.

The Washington leases are considered to be within an area attributed to Southern Coast Salish-speaking groups. That area is further broken down into two linguistic groups: Lushootseed (northern and southern dialects) and Twana. The lease areas are within the Northern Lushootseed dialect area. They are also just south of the Central Coast Salish linguistic group and likely experienced influences from this area and the Plateau culture region (Suttles and Lane 1990). The areas are just east of the historic villages of Miskaiwhu, Sauk, and Suiattle (Suttles and Lane 1990). As outlined in Appendix I, the earliest people to inhabit this area are referred to as Paleoindian, though there is little archaeological evidence that has been attributed to these populations. However, this may be due to the effects of sea level rise. The earliest definitive evidence for such early populations in the region is found in the Plateau culture region which is within a few miles of the lease areas (Neusius and Gross 2007).

Southern Coast Salish groups were initially small, mobile populations with large territories. Later as populations increased these groups became more sedentary with cyclical rounds of permanent village sites. Ethnographic accounts documented Southern Coast Salish tribes as organized based on village, household, and family groupings. Within this a hierarchy of members was developed. Additionally, villages established ties through marriages of high-ranking families. The Southern Coast Salish likely relied upon a variety of vegetal foods and terrestrial game than their neighbors. However fish, notably salmon, were also very important in the diet. When acquired in rivers, salmon were caught by weirs, traps, nets, gaff hooks, harpoons, and leisters. Shellfish and waterfowl were also collected and hunted in the region's rivers. Blacktail deer and elk were the primary targets for hunting using bow and arrow. Hunting was usually done individually with dogs to assist. In addition to the bow and arrow, hunters also used pitfalls, snares, and drives to get their prey. Woodworking was a principal craft of men in Southern Coast Salish tribes who constructed plank houses, household utensils, boxes, water containers, and canoes. Women used cedarbark to make cordage, mats, baskets, and blankets. Many of these perishable wood items are found in waterlogged archaeological sites of the region. Several types of canoes were the mode of transportation for people along the region's rivers (Suttles and Lane 1990).

A variety of historic-era activities have been documented within the region of the Washington leases. These included fur trapping during an initial period of Euro-American exploration, emigration and settlement by Euro-Americans and Canadians, trade between Native Americans and Euro-Americans, and missionization. By the 1850s many Southern Coast Salish were participating in Euro-American economies, selling a variety of items including furs, natural resources, and labor to non Salish. Agriculture, sawmills, and commercial fishing provided income and employment for others. The state became a territory in 1853 and treaties were made with the area's tribes. The Southern Coast Salish were party to the Treaties of Medicine Creek, Point Elliott, and Point No Point. These treaties reserved seven tracts of land for the Southern Coast Salish which eventually became reservations (Squaxin, Nisqually, Puyallup, Port Madison, Tulalip, Swinomish, and Skokomish). Many did not move on to these reservations however (Suttles and Lane 1990).

Data on cultural resources of the proposed were unavailable. As such, it is assumed that National Register of Historic Places (NRHP)-eligible resources are within the lease areas. It is also assumed that none of the leases have been previously surveyed. Until consultation with local Native Americans has been concluded, it is unknown if there are Native American sites or sacred sites within or adjacent to the lease areas.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on cultural resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on cultural resources; however, anticipated future actions following leasing would potentially result in such impacts. Completion of the Section 106 process of the National Historic Preservation Act requires the FS to consult with the State Historic Preservation

Office, tribes and other parties to identify and assess historic properties affected by the undertaking and develop measures to avoid, minimize, or mitigate any adverse effects of the undertaking on historic properties.

Given the assumptions of NRHP-eligible resources and lack of survey within the Mt. Baker-Snoqualmie lease sites, impacts on cultural resources could occur from subsequent permitted geothermal exploration, drilling operations and development, utilization, and reclamation and abandonment through ground-disturbing activities, unauthorized actions and alterations to setting and cultural landscapes. The nature of these impacts is described in Chapter 4 of Volume I of the PEIS. Additionally, as described in Chapter 2 of Volume 1 of the PEIS, various areas of cultural resources would have No Surface Occupancy stipulations: National Landmarks, National Register Districts, NRHP-listed and -eligible sites and their associated landscapes, traditional cultural properties, Native American sacred sites, and areas with important cultural and archaeological resources. Areas of potential effect would include access roads, well pads, power plant footprints, pipeline and transmission line routes, and construction staging areas as well as the boundaries of cultural resources those facilities cross and the aspects of setting that contribute to significance. These areas of potential effect would be developed at the project-specific level, and would require inventories, evaluations, and appropriate treatments as outlined in the best management practices of Appendix D in Volume III of the PEIS. Under these cultural resources best management practices, the BLM would also conduct Section 106 consultations with the State Historic Preservation Office, Native American tribes with ties to the project area, and local historic preservation groups to identify the presence and significance of cultural resources within or adjacent to the lease area and assess the level of impact of geothermal leasing and development on those resources. Project specific impacts after leasing would be reduced by implementing these best management practices.

17.3.12 Tribal Interests and Traditional Cultural Resources

Setting

Tribal interests include economic rights such as Indian trust assets, and resource uses and access guaranteed by treaty rights. Traditional cultural resources or properties include areas of cultural importance to contemporary communities, such as sacred sites or resource gathering areas. While most commonly considered in the context of Native Americans and Native Alaskans, there are traditional cultural resources associated with other ethnic or socially linked groups.

The Washington leases are considered to be within an area attributed to Southern Coast Salish-speaking groups, specifically the Northern Lushootseed dialect. They are also just south of the Central Coast Salish linguistic group and likely experienced influences from this area and the Plateau culture region (Suttles and Lane 1990). The areas are just east of the historic villages of Miskaiwhu, Sauk, and Suiattle (Suttles and Lane 1990).

By the 1850s many Southern Coast Salish were participating in Euro-American economies, selling a variety of items including furs, natural resources, and labor to non Salish. The Southern Coast Salish were party to the Treaties of Medicine Creek, Point Elliott, and Point No Point. These treaties reserved seven tracts of land for the Southern Coast Salish which eventually became reservations (Squaxin, Nisqually, Puyallup, Port Madison, Tulalip, Swinomish, and Skokomish); however, many did not move on to these reservations (Suttles and Lane 1990).

Data on Tribal Interests and Traditional Cultural Resources of the proposed lease areas were unavailable. Consultation with federally recognized tribes that are affiliated with the lease area was initiated on September 12, 2007 to identify and assess tribal concerns and traditional resources that may be affected by the undertaking. No responses from the tribes have been received as of the date of publication; however, the consultation process is considered on-going. While many traditional cultural resources are well known, some locations or resources may be privileged information that is restricted to specific practitioners or clans. For tribes, maintaining confidentiality and customs regarding traditional knowledge may take precedence over identifying and evaluating these resources, unless they are in imminent danger of damage or destruction.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on tribal interests and traditional cultural resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on tribal interests and traditional cultural resources; however, anticipated future actions following leasing would potentially result in such impacts. Impacts on tribal interests and traditional cultural resources are assessed using the criteria found in Chapter 4 of Volume I the PEIS. Because issuing geothermal leases confers on the lessee a right to future exploration and development of geothermal resources within the lease area, it is a commitment or granting of a right that may interfere with other uses or interests. Although no tribal interests or concerns have been identified by the consultation process, the process is considered on-going and such resources may be identified in the future by tribes. Impacts on tribal interests would be minimized or avoided by implementing best management practices in Appendix D of Volume III of the PEIS for each of the phases of the Reasonably Foreseeable Development scenario as described in Chapter 2 of Volume I of the PEIS.

For traditional cultural resources, completion of the Section 106 process of the National Historic Preservation Act requires the FS to consult with the State Historic Preservation Office, tribes and other parties to identify and assess historic properties affected by the undertaking and develop measures to avoid, minimize, or mitigate any adverse effects of the undertaking on historic properties which includes traditional cultural properties. No Traditional Cultural Resources have been identified by consulted tribes thus far, but consultation is considered on-going. Additionally, archaeological resources such as those discussed in Section 16.3.12, *Cultural Resources*, are often considered traditional resources by tribes.

Impacts on traditional cultural resources could occur from subsequent geothermal exploration, development, production and closeout through ground-disturbing activities, unauthorized actions and alterations to setting and cultural landscapes. The nature of these impacts and mitigations are described in Chapter 4 of Volume I of the PEIS. Areas of potential effect would include access roads, well pads, power plant footprints, pipeline and transmission line routes, and construction staging areas as well as the aspects of setting that contribute to significance. These areas of potential effect would be developed at the project-specific level, and would require inventories, evaluations, and appropriate treatments as outlined in the best management practices of Appendix D in Volume III of the PEIS. Under these cultural resources best management practices the FS would also conduct Section 106 consultations with the State Historic Preservation Office, Native American tribes with ties to the project area, and local historic preservation groups to identify the presence and significance of cultural resources within or adjacent to the lease area and assess the level of impact of geothermal leasing and development on those resources. Project specific impacts after leasing would be reduced by implementing these best management practices.

17.3.13 Visual Resources

Setting

This section describes the visual resources in the region of influence, which is defined as the areas within and immediately surrounding the proposed lease sites. Described below is the method for managing scenic resources and the visual landscape of the lease area.

The scenery of the Forest is managed through the application of the Visual Management System (Agricultural Handbook- 462, National Forest Landscape Management, Volume 2, Chapter 1, The Visual Management System). The Visual Management System was adopted by the Forest Service in 1974. The key component of the Visual Management System is the establishment of Visual Quality Objectives within the Land and Resource Management Plan.

There are five differing levels of Visual Quality Objectives: Preservation, Retention, Partial Retention, Modification, and Maximum Modification. The following is a brief description of the five Visual Quality Objectives:

- Preservation – Allows ecological change only. Management activities are prohibited except for very low visually impacting recreation facilities.
- Retention – Management activities may not be visually evident. Contrasts in form, line, color and texture must be reduced during or immediately after the management activity.
- Partial Retention – Management activities must remain visually subordinate to the characteristic landscape. Associated visual impacts in form, line, color and texture must be reduced as soon after project completion as possible but within the first year.
- Modification – Management activities may visually dominate the characteristic landscape. However, landform and vegetative alterations must borrow from naturally established form, line, color or texture so as to blend in with the surrounding landscape character. The objective should be met within one year of project completion.
- Maximum Modification – Management activities including vegetative and landform alterations may dominate the characteristic landscape. However, when viewed as background they must visually appear as natural occurrences within the surrounding landscapes or character type. When viewed as foreground or middle ground, they may not appear to completely borrow from naturally established form, line, color, or texture. Alterations may also be out of scale or contain detail which is incongruent with natural occurrences as seen in foreground or middle ground. Reduction of contrast should be accomplished within five years.

Most of the NFS land in the vicinity of Baker Lake is assigned the Visual Quality Objectives of retention, partial retention, and modification (Federal Energy Regulatory Commission 2006). All forest lands around Baker Lake are designated as partial retention. Areas where timber has been harvested on ridges surrounding the lake have been assigned a Visual Quality Objective of modification. The mountains to the east and west are designated retention.

According to the Final Environmental Impact Statement for the Mount Baker-Snoqualmie National Forest Land and Resource Management Plan, the Mount Baker-Snoqualmie National Forest contains some of the nation's most scenic forest landscapes and a wide variety of visual settings or scenes (US Forest Service 1990). Lush, low-elevation forests contrast sharply with the glaciated peaks and ridges of the North Cascade Mountains. Major mountain peaks located within the Forest are dominant focal points for the forest visitors. Contrasting with this natural landscape are human modifications, including roads, rockpits, utility corridors, ski areas, and the activities associated with timber harvesting. Clearcut patterns resulting from past timber harvest are the most visually evident. However, natural appearing environments exist on much of the Forest, even where extensive timber harvest and other activities are occurring.

The proposed lease areas are on the southeastern slopes of Mt Baker (approximately 10,700 feet) between the summit and both Baker Lake Highway and Baker Lake. The closest lease area to the lake is approximately a half a mile away, and the furthest is approximately six miles away.

The Baker River watershed is generally very steep, with slopes from 20 to 40 percent over most of its area, with the exception of the valley bottom along the Baker River channel and some of its major tributary streams (Federal Energy Regulatory Commission 2006). The middle portion of the basin, the site of Baker Lake, is a more confined valley where glacial and stream sediments have been covered by mudflows and recent alluvial deposits. At the upper reaches of the watershed, Mount Baker, Mt. Shuksan, and their adjacent ridges and pinnacles form a spectacular alpine topography that dominates the landscape.

Baker Lake is a narrow 4,800-acre, 9-mile-long reservoir in the center of the Baker River watershed (Federal Energy Regulatory Commission 2006). It is set in dramatic terrain, surrounded by forested ridges rising to about elevation 4,100 feet on the west side. The western ridges are the foothills of Mount Baker.

The sloped terrain found in the lease areas are mostly covered with a coniferous forest of varying heights and maturity, except where a patchwork of clear cuts occurs. Ridges, canyons, and strings of dirt roads for logging cross the lease areas.

Human-made modifications to the visual landscape are limited to roads of various conditions and recreation areas. Hiking, backpacking, cross country skiing, and snowshoeing activities occur in all of the lease areas.

Impacts

For the purpose of this analysis, it is assumed the lease areas on FS land are designated with a Retention or Partial Retention Visual Quality Objective.

Alternative A (No Action)

There would be no impacts on, or changes to, visual resources.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on visual resources; however, anticipated future actions following leasing would potentially result in such impacts. The potential risk of changes affecting visual resources is assessed for five significance criteria, which are described in the PEIS. Future actions based on the Reasonably Foreseeable Development scenario could result in changes that impact visual resources.

Future geothermal development activities could involve new structures, roads, and operations that are described in the Reasonably Foreseeable Development scenario. The new structures, roads, and operations would alter the characteristic landscape and be sources of light and glare. Depending on their exact location, they could also diminish scenic views afforded individuals participating in recreation activities. These impacts would be noticeable, because they would be in areas that are relatively undeveloped and would be near areas where various recreation activities occur year-round. It is assumed the stipulations outlined in Chapter 2 of the PEIS would result in positioning new structures, roads, and operations in the landscape so they would remain visually subordinate to the characteristic landscape. As a result, changes to visual resources based on the Reasonably Foreseeable Development scenario would result in impacts on visual resources that would be consistent with the Partial Retention Visual Quality Objectives.

The Forest Plan requires foreground retention for primary road corridors. Primary road corridors exist in the southern three lease areas. If sited within areas of *Scenic Viewshed: Foreground*, developments would not likely meet the Retention Visual Quality Objective.

17.3.14 Socioeconomics and Environmental Justice

Setting

The leasing area covers approximately 9,450 acres within Whatcom County, Washington. Whatcom County was selected as the ROI for socioeconomic analysis as the impacts of leasing are likely to occur within this region. A summary of the population, housing, employment, local school data and low-income and minority populations for the County is provided based primarily on data from Census 1990 and 2000 population, demographic and housing information (US Census Bureau 1990, 2000).

Population

Most recent population data estimates Whatcom county population at 185,953 in 2006, (US Census Bureau 2008), representing an 11.5 percent increase from 2000. From 1990 to 2000, there was an approximate 23 percent increase in population (US Census Bureau 1990, 2000).

Housing

In 1990, a total of 55,742 housing units were in the county; of these approximately 87 percent were occupied and 56 percent occupied by owner. In 2000, the total number of housing units increased to 73,893. The percent of total occupied units and owner occupied units has remained constant at 87 percent and 55 percent respectively. Homeownership rates are approximately the same as for the state of Washington as a whole (US Census Bureau 1990, 2000).

Employment

In 1999 the workforce consisted of 87,365 total people of which 4.9 percent were unemployed. In 1990 the labor force was 64,773 and unemployment was 4.8 percent. Median household income in the County was $40,405 in 2000, which was below the state average of $45,776 at that time (US Census Bureau 1990, 2000).

The industries employing the largest percent of the population in 1999 were education, health and human services (20.9 percent); retail trade (14.4 percent); manufacturing (12.1 percent); and arts, entertainment, recreation, accommodation and food services (9.6 percent) (US Census Bureau 2000).

Schools and Public Infrastructure

Total K-12 school enrollment in Whatcom County in 2000 was approximately 29,602. In 1990 enrollment was 21,174. Based on current population trends, enrollment is likely to continue to increase (US Census Bureau 1990, 2000).

Environmental Justice

In Whatcom County 88.4 percent of the population identified themselves as White of non-Hispanic descent in the 2000 census. The percent of population representing minority racial or ethnic groups has dramatically increased over the past two decade; the Hispanic/Latino population increased 134 percent between 1990 and 2000 and as of 2006 comprised 6.2 percent of the population, while the Asian American population increased by 94 percent for the same period and made up 3.5 percent of the population in 2006 (US Census Bureau 1990, 2000, 2008). Additional details are provided in Table 17.3-3.

2006 poverty status estimates indicate that 13.2 percent of individuals were living below the poverty line in Whatcom County. This is slightly higher than the state average of 11.6 percent. Census data indicates that 14.2 percent of individuals were below the poverty level in 2000 and 12.2 percent in 1990 (US Census Bureau 1990, 2000).

Table 17.3-3
Race/Ethnicity in Whatcom County

	1990	2000	Percent Change
Total Population	127,780	166,814	30.5
White	119,229	147,485	23.6
Black/African American	650	1,150	43.5
American Indian/Alaskan Native	4,014	4,709	17.3
Asian	2,363	4,637	96.2
Pacific Islander*	N/A	235	N/A
Other	1,524	4,159	173
Two or more*	N/A	4,439	N/A
Hispanic or Latino**	3,718	8,687	134

Source: US Census Bureau 1990, 2000.
* Not reported on1990 census: Asian and Pacific Islanders were one group and more than one race was not an option.
** In combination with other race. Totals may add to more than 100 percent as individuals can report more than one race.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on existing socioeconomics in Whatcom County. No impacts would occur to minority or low income populations.

Alternative B (Proposed Action)

The Proposed Action would have no direct impacts on socioeconomics or environmental justice; however, anticipated future actions following leasing would potentially result in such impacts. Potential impacts include an increase in jobs and decrease in unemployment in Whatcom County due to construction and operations and maintenance jobs at newly developed geothermal plants.

Geothermal development would also be a positive stimulus to the local economy through tax revenues for Whatcom County and the State of Washington.

A general discussion of the impacts of geothermal leasing for a 50 MW plant is provided in Section 4 of the PEIS under *Socioeconomics and Environmental Justice*. Similar impacts to those discussed in the PEIS are likely for this lease area.

Due to the lack of residential areas in the vicinity of the lease area, there would be no disproportionate impacts on minority or low income populations.

17.3.15 Noise

Setting

Current sources of noise in the lease sites are limited to wind, dispersed recreational use, traffic from roads within the lease site boundaries, and wildlife. Sources of noise originating outside of the lease sites but affecting the lease sites include road and air traffic, and recreational use. Sensitive noise receptors are generally considered to be homes, hospitals, schools, and libraries. No buildings or developments exist in or within half a mile of the lease area.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on noise.

Alternative B (Proposed Action)

Neither the Proposed Action, nor anticipated future actions following leasing, would have any direct impact on noise since no sensitive receptors have been identified within or adjacent to the lease sites.

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FES 08-44

FINAL

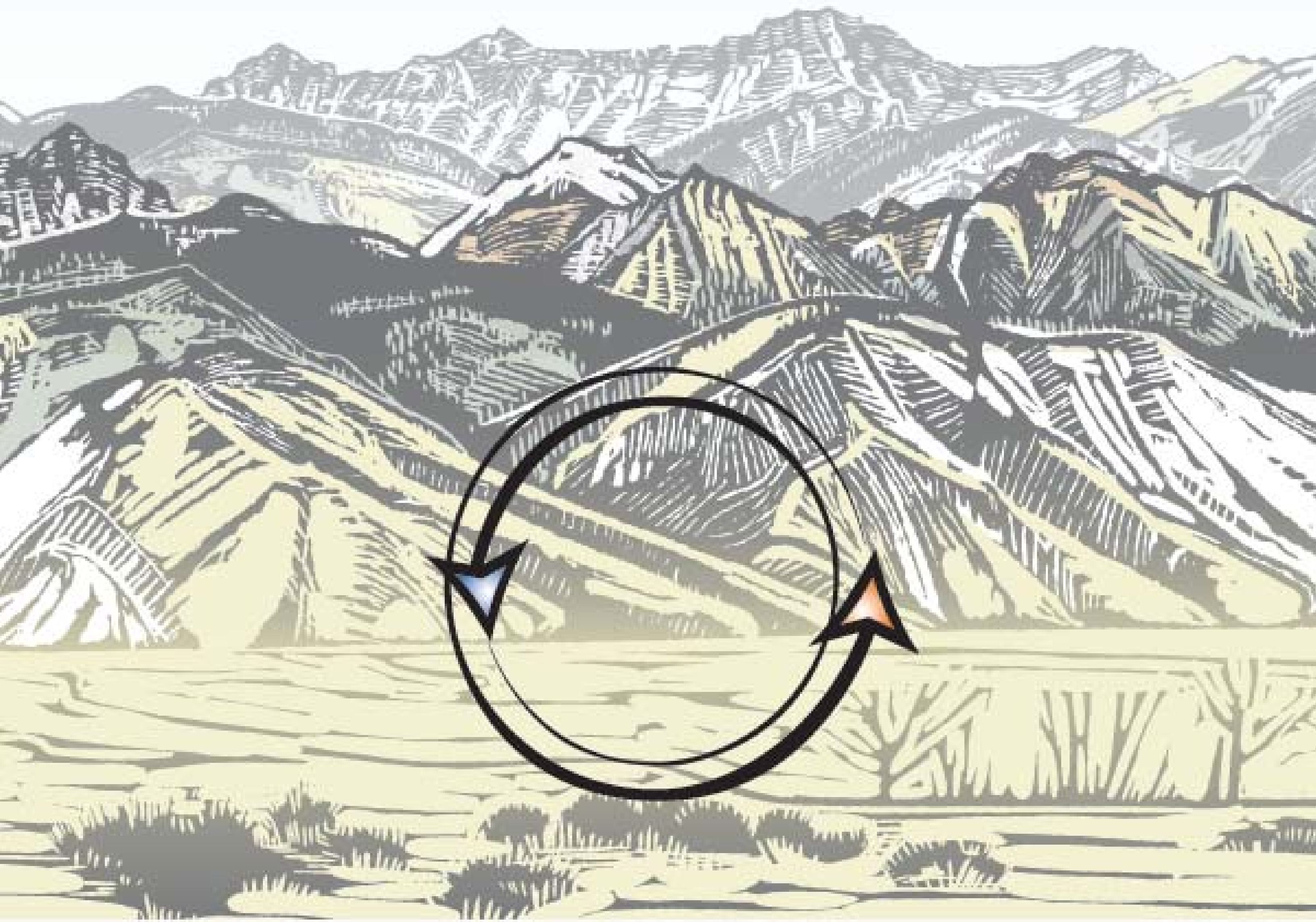
Programmatic Environmental Impact Statement for

Geothermal Leasing

in the Western United States

Volume III: Appendices

October 2008



FES 08-44

FINAL

PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT FOR

GEOTHERMAL LEASING IN THE WESTERN UNITED STATES

VOLUME III: APPENDICES

OCTOBER 2008

US DEPARTMENT OF THE INTERIOR

BUREAU OF LAND MANAGEMENT

US DEPARTMENT OF AGRICULTURE

UNITED STATES FOREST SERVICE

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VOLUME III: APPENDICES

Appendix

LIST OF ACRONYMS

ACEC - Area of Critical Environmental Concern

ADR - Alternative Dispute Resolution

ANCSA - Alaska Native Claims Settlement Act

ANILCA - Alaska National Interest Lands Conservation Act

APD - Application for Permit to Drill

AUM - Animal Unit Month

BLM - United States Department of the Interior, Bureau of Land Management

BMPs - Best Management Practices

C - Celsius

CA - Conservation Agreement

CERCLA - Comprehensive Environmental Response, Compensation and Liability Act

CEQ - Council on Environmental Quality

CFR - Code of Federal Regulations

COAs - Conditions of Approval

CS - Conservation Strategy

CSU - Controlled Surface Use

CX (or CE) - Categorical Exclusion

DM - Departmental Manual

DNA - Documentation of Land Use Plan Conformance and National Environmental Policy Act (NEPA) Adequacy

DOI - Department of the Interior

DR - Decision Record (for an EA)

EA - Environmental Assessment

EFH - Essential Fish Habitat

EIS - Environmental Impact Statement

EPAct of 2005 - Energy Policy Act of 2005 (Public Law 109-58, August 8, 2005)

ESA - Endangered Species Act

F - Fahrenheit

FACA - Federal Advisory Committee Act

FLPMA - Federal Land Policy and Management Act of 1976 (43 United States Code 1701 et seq.)

FONSI - Finding of No Significant Impact

FS - United States Department of Agriculture, Forest Service

FWS - Fish and Wildlife Service

GIS - Geographic Information System

IBLA - Interior Board of Land Appeals

ITAs - Indian Trust Assets

IMP - Interim Management Policy

KGRAs - Known Geothermal Resource Areas

LAC - Limits of Acceptable Change

LUP - Land Use Plan

MFP - Management Framework Plan

MOU - Memorandum of Understanding

NEPA - National Environmental Policy Act of 1969

NFMA - National Forest Management Act of 1976

NFS - National Forest System

NGD - No Ground Disturbance

NHPA - National Historic Preservation Act

NLCS- BLM's National Landscape Conservation System

NMFS - National Marine Fisheries Service

NOA - Notice of Availability

NOAA - National Oceanographic and Atmospheric Administration

NOI - Notice of Intent

NPS - National Park Service

NRCS – National Resources Conservation Service

NREL - US DOE National Renewable Energy Laboratory National Renewable Energy Laboratory

NRHP - National Register of Historic Places

NSO - No Surface Occupancy

OSHA - Occupational Safety and Health Administration

OHV - Off-Highway Vehicle

PAC - Provincial Advisory Council

PEIS - Programmatic Environmental Impact Statement

PFYC – Potential Fossil Yield Classification

PM10 - Particulate Matter Less than 10 Micrometers in Diameter

PM2.5 - Particulate Matter Less than 2.5 Micrometers in Diameter

POD - Plan of Operation and Development

Ppm - Parts per Million

RAC - Resource Advisory Council

RFD - Reasonably Foreseeable Development

RMP - Resource Management Plan

RNA - Research and Natural Area

ROD - Record of Decision (for an EIS)

ROS - Recreation Opportunity Spectrum

ROW- Right of Way

SMS - Scenery Management System

T&E - Threatened and Endangered

TL - Timing Limitation

TMDL -Total Maximum Daily Load

US - United States

USC - United States Code

USDA - United States Department of Agriculture

US DOE - United States Department of Energy

US DOI - United States Department of the Interior

US EPA - United States Environmental Protection Agency

USGS - United States Geological Survey

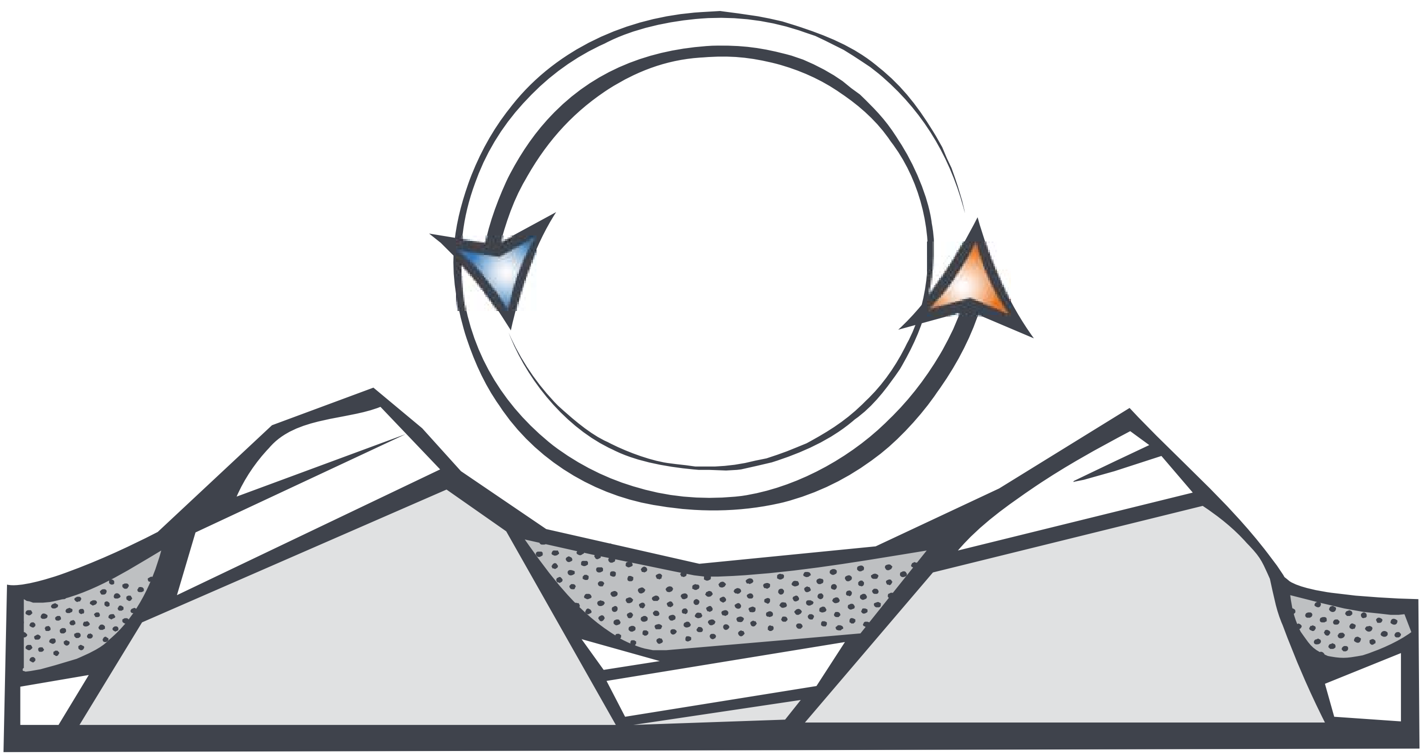
USFWS - United States Department of Interior, Fish and Wildlife Service

VRM - Visual Resource Management

WGA - Western Governors Association

WSR - Wild and Scenic River

WSA - Wilderness Study Area



Appendix A

Status of US Geothermal Energy and Permitting in the Western States and Tribal Lands

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Status of US Geothermal Energy and Permitting in the Western States and Tribal Lands

www.blm.gov

www.fs.fed.us

www.EMPSi.com

Status of US Geothermal Energy and Permitting in the Western States and Tribal Lands

October 2008

prepared
by

Environmental Management and Planning Solutions Inc.

Western States Summary

Introduction

This report details the current status of geothermal resources and development for each of the 12 western states covered in this PEIS: Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington and Wyoming. The report contains focused information on resource geography, current and proposed geothermal utilization, technical capabilities in the form or public and private research and investment, a look at geothermal resources on tribal lands within each state, and state geothermal regulations and the agencies responsible for the oversight of geothermal resources. Additional requirements and considerations for pursuing geothermal resource development on tribal lands follow the state status section.

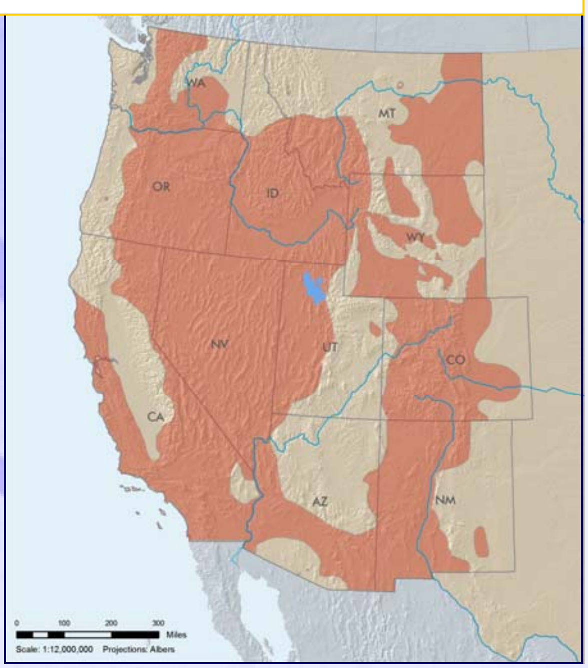
The Western States

- Alaska
- Arizona
- California
- Colorado
- Idaho
- Montana
- Nevada
- New Mexico
- Oregon
- Utah
- Washington
- Wyoming

Areas of Geothermal Potential in Alaska

In total, about 530 million acres in the 12 western states, including Alaska, are identified as having geothermal potential for indirect or direct applications, with about 480 million acres providing potential for electrical production. The hottest resources and where commercial electrical generation would most likely occur, are generally within central and northern Nevada, western Utah, southern and central Idaho, southern and northeastern California, southeast Oregon, and along the Cascade mountain range.

Areas of Geothermal Potential in the Western States



Estimates of short term (2015) and long term (2025) electrical power generated from geothermal resources provided in this report are derived primarily from the Western Governors' Task Force Report (WGA 2006), with input from state geothermal programs and others in the geothermal industry. Thirty year estimates of potential electrical generation capacity from identified geothermal resources come from the United States Geologic Survey (USGS) report, released October 2008 tilted *Assessment of Moderate- and High-Temperature Geothermal Resources of the United States.*

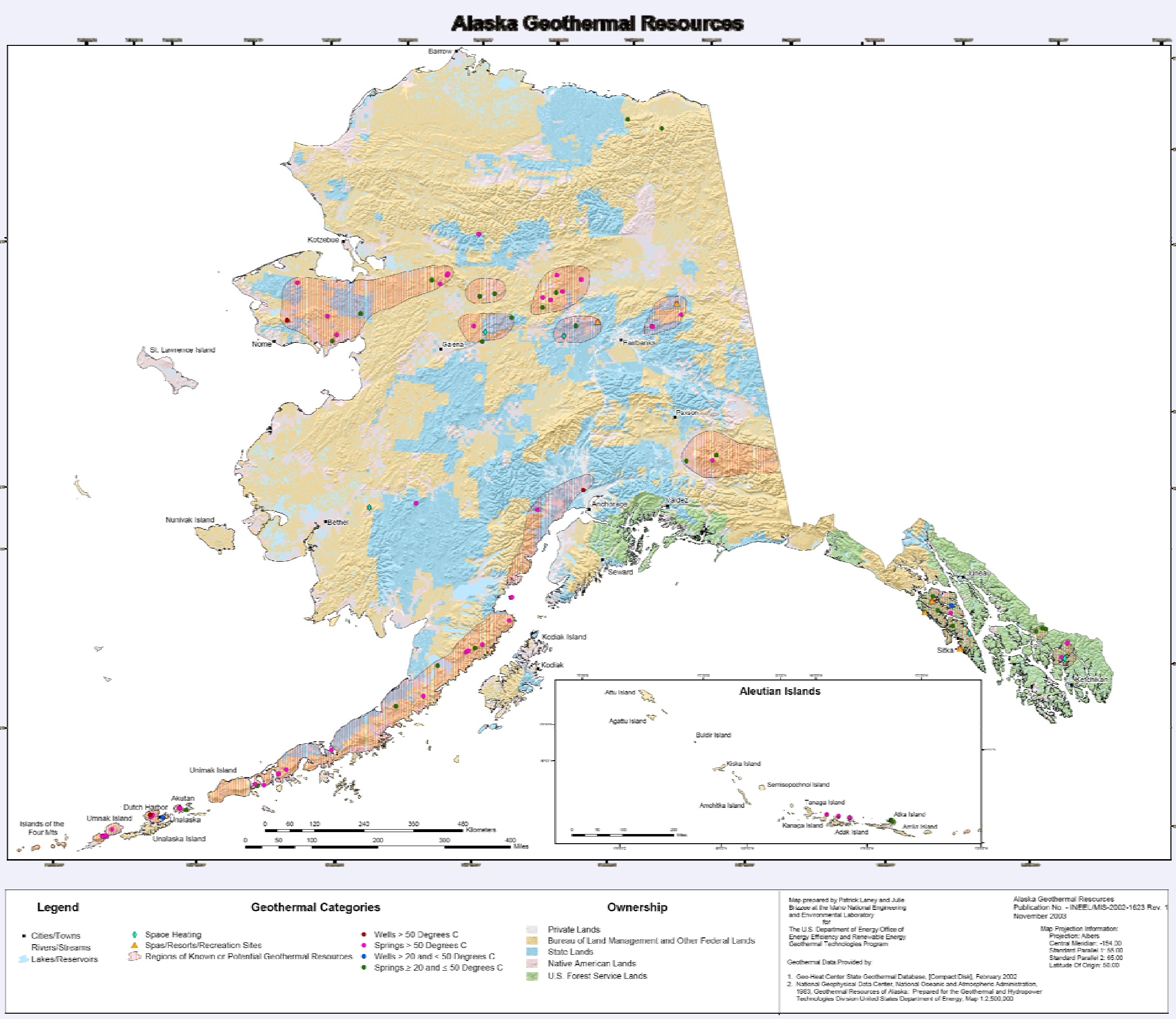
ESTIMATED CAPACITY

The USGS (2008) estimates 8,876 megawatts (MW) of electrical power could be generated from identified geothermal resources in the Western United States. The mean estimated power production resources from undiscovered resources is 27,598 MW, bringing the total estimated mean capacity for electrical power production from geothermal to 34,474 MW. Additionally, estimated potential for new technologies range from 345,100 to 727,900 MW.

Alaska

Resource Geography

Alaska has four distinct geothermal resource regions: The Aleutian Volcanic Arc (which includes the Aleutian Islands as well as the Alaska Peninsula and Cook Inlet volcanoes), The Central Alaskan Hot Springs Belt (CAHSB), The Wrangell Volcanic Cluster, and The Alaskan Panhandle (Kolker 2007). The CAHSB has low to moderate temperature resources while the Aleutian Volcanic Arc holds high-temperature geothermal systems (Crimp 2006). The Wrangell Volcanic Cluster may have the potential for geothermal energy development: The Eastern Copper River Basin (ECRB), close to the western part of the Wrangell volcanoes, has been the subject of geothermal exploration because it contains mud volcanoes, unusual features associated with pressurized groundwater and/or hydrothermal aquifers. Little is known of the potential of the Alaskan Panhandle as no exploration of sites (beyond temperature measurements and aquatic geochemical surveys) has been performed.



Laney, 2003a, http://geothermal.id.doe.gov/maps/ak.pdf

Alaska

Utilization

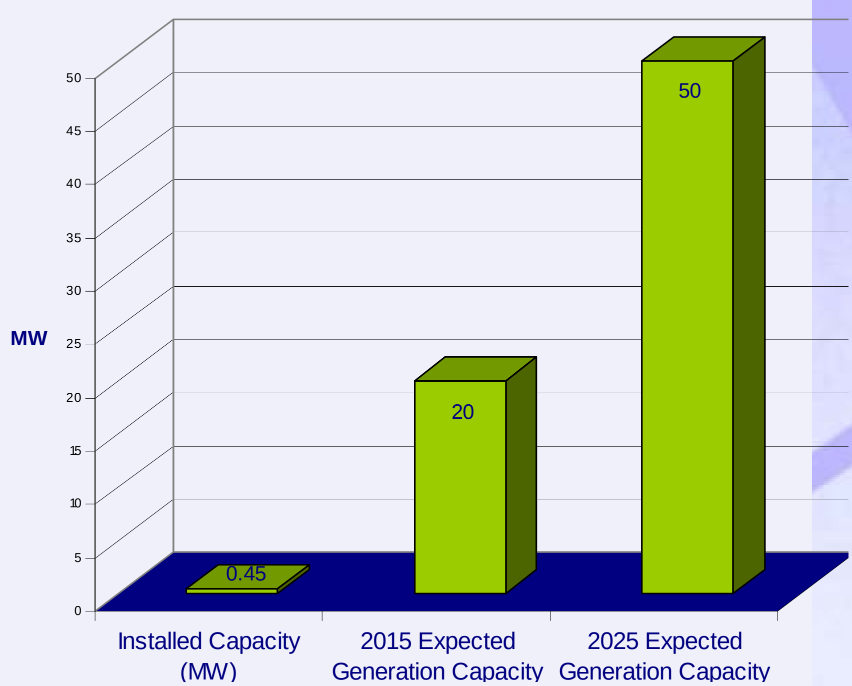
Initial exploration efforts occurred during the 1970s and 80's to help define resource locations but inadequate funding stalled more substantive development. Currently field investigations are on-going to characterize and further identify geothermal areas, particularly near the Chena Hot Springs Resort, where the state's only current geothermal power plant (a two-unit binary system) came on-line in 2006 providing power to the resort and as a demonstration plant. The Chena Hot Springs plant is unique in that it is capable of producing power from a low-temper-ature aquifer (demonstrating the recent advances made in geothermal technology) (USDOE 2007a).

ESTIMATED CAPACITY

The USGS (2008) estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Alaska during the next 30 years at 677 MW, with a total low-high range of 236 MW to 1,359 MW.

Geothermal energy is not presently used for large-scale electricity production. Direct-use applications such as building heating are common throughout the state and many surface resources have been developed for recreational purposes. The most difficult challenges facing geothermal power plant development in Alaska are the remote locations of known or potential geothermal resource areas, placing potential generation facilities far from existing transmission lines and resulting in high capital costs to build power plants.. A high-temperature (above 302 degrees Fahrenheit [°F], 150 degrees Celcius [°C]) hydrothermal reservoir identified on Unalaska Island has been considered for the development of a 15 MWe (megawatts electric) power plant to supply the city of Unalaska and Dutch Harbor, one of the nation's most active seaports. In addition, the State of Alaska is proposing approximately 36,057 acres in 16 tracts on the south flank of Mount Spurr for geothermal exploration and development (Mount Spurr Geothermal Lease Sale No. 3). On September 10, 2008, the Mount Spurr lease sale was held. The area lies entirely within the Kenai Peninsula Borough, approximately 40 miles west of the village of Tyonek and about 80 west of Anchorage (Diel, 2008). However, the challenges of transmitting the electricity over the terrain separating the energy source from the city, coupled with subsidies for diesel generation, have necessitated additional feasibility studies to implement geothermal power (USDOE 2007a). Field exploration of the leases would likely start in the summer of 2009 (MacKenzie 2008).

Geothermal Electrical Generation



WGA 2006

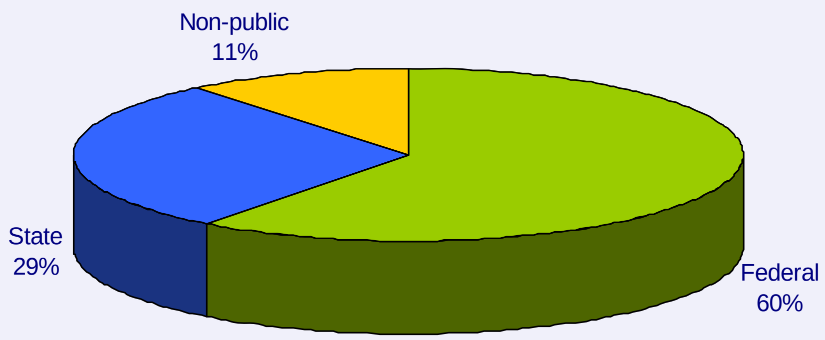
Alaska

Laws and Regulations

Alaska classifies geothermal resources as Mineral (though waters below 120°C are available for appropriation as groundwater and are subject to ground water law statutes), and the state claims ownership of all geothermal resources, including those under private lands. The state gives the landowner preferential right to prospecting permits and/or leases.

The Alaska Department of Natural Resources, Division of Oil and Gas, is responsible for the development of the state's geothermal resources (Battocletti 2005). Alaska has established a Geothermal State Working Group with leadership from the Alaska Energy Authority. The Alaska group brings together state and regional energy professionals to promote the increased utilization of the state's geothermal resources (USDOE 2007a). The state presently has no renewable portfolio standard (RPS) or renewable energy standard (RES) (Richter 2007). Alaska has no state funding allocated specifically for geothermal resource development. The state has not passed greenhouse gas (GHG) reduction legislation but established a Climate Impact Assessment Committee in 2006 to examine and prepare recommendations regarding potential future GHG legislation (Camp 2007). The Alaska State Chamber of Commerce published a document in January 2008 in support of a state-wide energy policy that includes the study and development of Alaska's geothermal resources (ACC 2008).

Land Ownership



NRCM 2008

Alaska

Technical Capabilities

Alaska universities, state agencies, and private firms contribute technical capabilities to the local and national geothermal communities. The University of Alaska has participated in various research and exploration projects throughout Alaska, including the investigation of the Chena Hot Springs area (USDOE 2007a).

Electrical Power Generation and Capacity

Alaska has an installed geothermal electricity production capacity of 0.45 megawatt (MW) with a running capacity of 0.40 MW, all of which comes solely from the Chena plant. Four projects are in development, with a total potential capacity of 45.6-60.6 MW; 20 MW in the short-term (2015), 50 MW in the long-term (2025) (WGA 2006). The USGS report titled *Assessment of Moderate- and High-Temperature Geothermal Resources of the United States* provides a mean probability of electrical power generation for identified geothermal resources on all lands in Alaska during the next 30 years at 677 MW, with a total low-high range of 236 MW to 1,359 MW(USGS 2008).

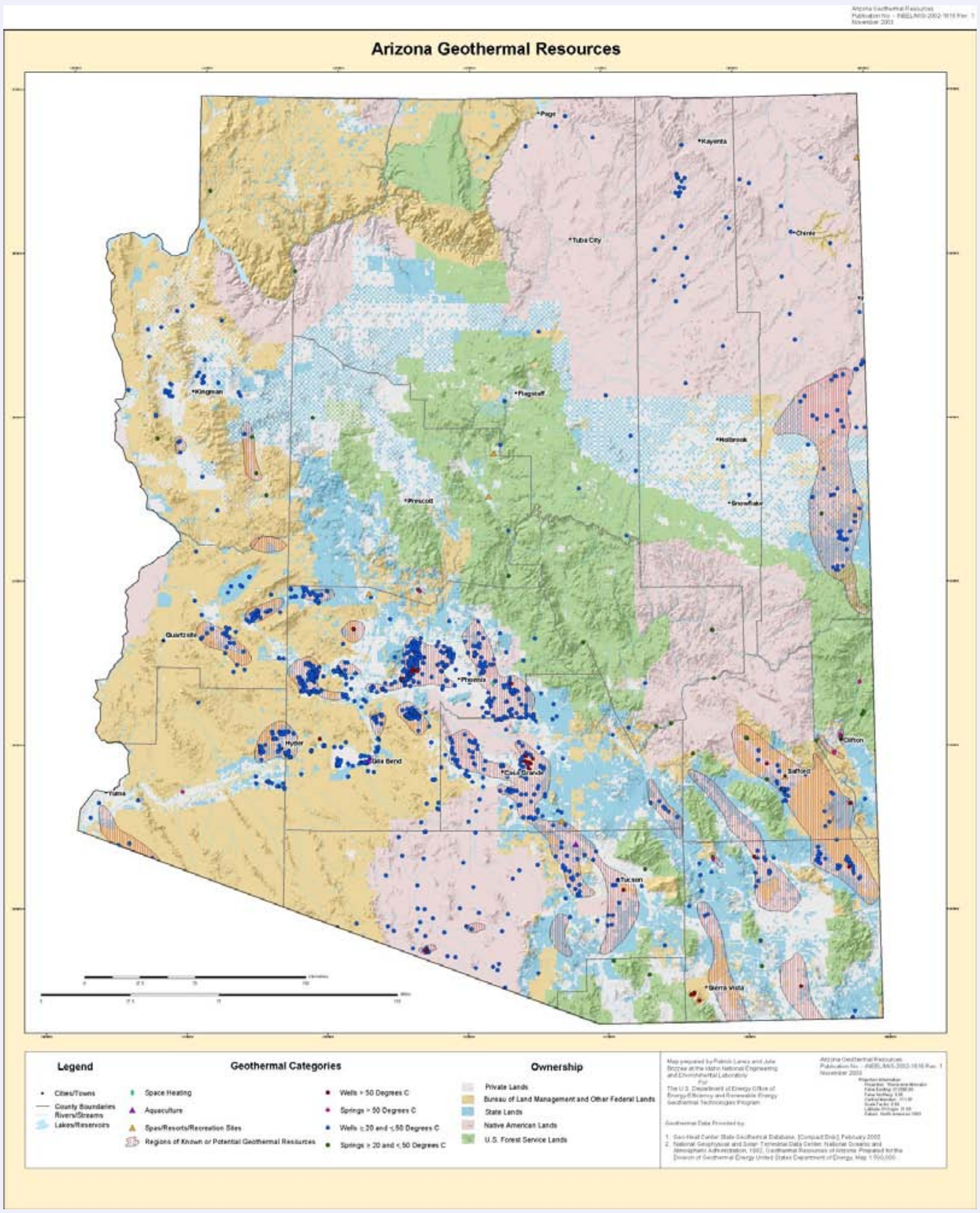
Tribal Lands

The NANA Regional Corporation is currently conducting a Geothermal Assessment Program Feasibility Study to assess potential for power generation on Native Alaska lands in the NANA region (NANA 2007). Source: NANA regional Corp website: http://www.eere.energy.gov/tribalenergy/pdfs/0711review_nana.pdf.

Arizona

Resource Geography

High-temperature geothermal resources have yet to be discovered in Arizona; most known resources of any temperature are located south of the Colorado plateau. Three locations: Buckhorn Baths in Apache Junction, Castle Hot Springs in the Bradshaw Mountains, and Childs on the Verde River exhibit potential for geothermal resources and may warrant exploration (ADC 2008), while geothermal development plans for the counties of Cochise, Graham, Greenlee, Maricopa, Pima, Pinal, Santa Cruz and Yuma were completed in the 1970s (USDOE 2007a).



Laney, 2003a, http://geothermal.id.doe.gov/maps/az.pdf

Arizona

ESTIMATED CAPACITY

The USGS (2008) estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Arizona during the next 30 years at 26 MW, with a total low-high range of 4 MW to 70 MW.

Utilization

Current development focuses on direct, recreational, and therapeutic use, particularly aquaculture, agriculture and spas. Indirect-use research is on-going: A United States (U.S.) Department of Energy (DOE) grant to drill an exploration well near Clifton Hot Springs in Greenlee County was awarded to the joint groups of Arizona Public Service (APS), Northern Arizona University, Arizona State University, New Mexico University and the Ormond Group (USDOE 2007a). The water temperature ranges from 158-180° F (302-356° C) (ADC 2008). Researchers anticipate this area has the potential to generate 20 MW of electric power (USDOE 2007a). A geothermal power plant has been in planning for several years at this site, but confirmation drilling is required before construction can begin. Northern Arizona University also received US DOE funding to perform geophysical and geochemical testing in the previously unexplored areas of San Francisco Volcanic Field (ADC 2008, Fleischmann 2007).

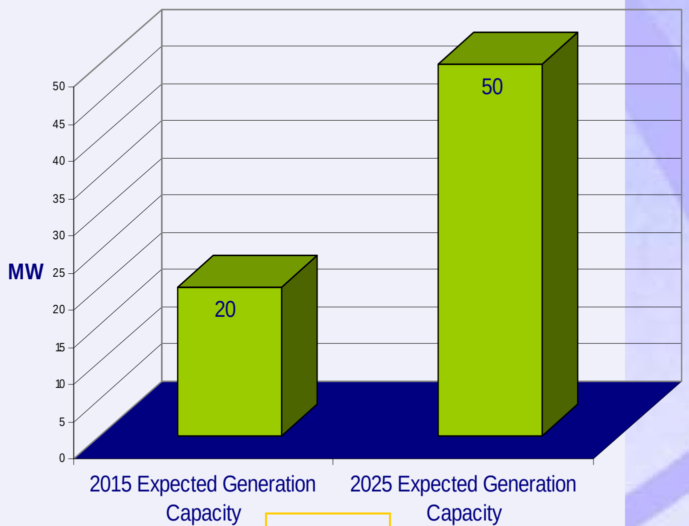
Technical Capabilities

There are several agencies, universities, and private companies assisting in the efforts to further explore Arizona's geothermal capabilities. This collaboration includes: Vulcan Power, Northern Arizona University, Arizona State University, New Mexico University, Arizona Public Service, and the Ormond Group. Northern Arizona University (NAU) is also participating in outreach efforts to educate Arizona's population regarding geothermal resources in addition to it's San Francisco research (USDOE 2007a).

Electrical Power Generation and Capacity

No geothermal plants exist in the state as of present. One project (Clifton Hot Springs) is currently in development, with a projected potential of 2-20 MW, 20 MW short-term and 50 MW long-term (WGA 2006). The USGS report titled *Assessment of Moderate- and High-Temperature Geothermal Resources of the United States* estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Arizona during the next 30 years at 26 MW, with a total low-high range of 4 MW to 70 MW (USGS 2008).

Geothermal Electrical Generation



WGA 2006

Tribal Lands

Tribal lands in Arizona make up roughly 27 percent of the state's land. No geothermal direct use facilities are known to be operating on these lands. Those who work with tribes in Arizona assert that continued education and public involvement are essential if tribal leaders will pursue geothermal projects (Fleischmann 2007). Maps and data for geothermal resources on tribal lands in Arizona are available through the DOE tribal energy program at: http://www1.eere.energy.gov/tribalenergy/guide/geo_arizona.html (USDOE 2007b).

Arizona

Tribes with Potential Geothermal Resources in Arizona
Ak Chin Indian Community of the Maricopa Indian Reservation
Cocopah Tribe
Colorado River Indian Tribes of the Colorado River Indian Reservation
Fort Apache Reservation
Fort McDowell Yavapai Nation of the Fort McDowell Indian Reservation
Fort Mojave Indian Tribe
Fort Yuma Indian Reservation
Gila River Indian Community of the Gila River Indian Reservation
Havasupai Tribe of the Havasupai Reservation
Hopi Tribe of Arizona:
San Carlos Apache Tribe of the San Carlos Reservation
Northern lands
Eastern lands
Southwestern lands
Kaibab Indian Reservation
Hualapai Indian Tribe of the Hualapai Indian Reservation:
San Juan Southern Paiute Tribe
Northern lands
Southern lands
Maricopa Indian Community of the Salt River Reservation
Maricopa Indian Reservation
Navajo Nation:
Four Corners Region lands (Northeast Arizona, Northwest New Mexico, and Southeast Utah)
North Central Arizona and Central Utah lands
East Central lands in Arizona
Four Corners Region lands (Northeast Arizona, Northwest New Mexico, and Southeast Utah)
Southeastern lands in Arizona
Southwestern lands in Arizona
Paiute Indians of the Kaibab Indian Reservation
Pascua Yaqui Tribe
Quechan Tribe of the Fort Yuma Indian Reservation
Salt River Pima-Maricopa Indian Community of the Salt River Reservation
Salt River Reservation
Tohono O'odham Nation
Tonto Apache Tribe
White Mountain Apache Tribe of the Fort Apache Reservation
Yavapai-Apache Nation
Yavapai-Prescott Tribe of the Yavapai Reservation

Arizona

Laws and Regulations

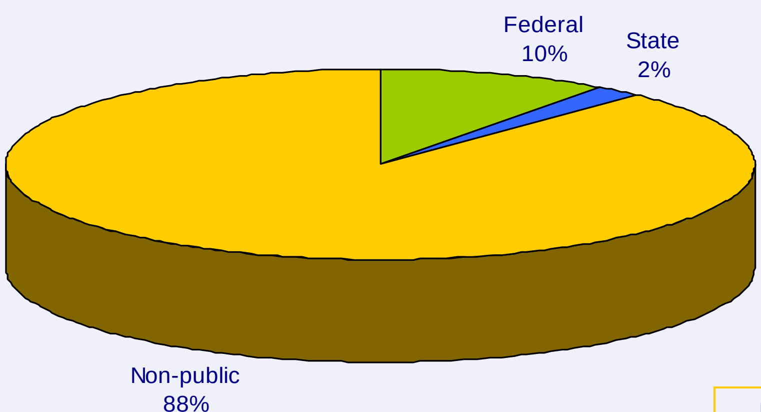
The State of Arizona classifies geothermal resources as *sui generis,* indicating that they are not covered by a 'Use Class' but effectively are in a class of their own. The state claims ownership of all geothermal resources on state lands and reserves the right to lease or withhold these state lands for the purpose of leasing (Battocletti 2005).

Several state agencies are involved with any potential geothermal project. The Arizona Department of Environmental Quality (DEQ) is responsible for the disposal of waters associated with geothermal projects. The State Department of Water resources must be consulted to obtain well construction permits and to secure water rights, and the Department of Commerce Community Planning Office should be contacted regarding planning and zoning issues across the state (Battocletti 2005). Arizona's Geothermal Working Group has established two primary tasks: collecting data on all of the current state geothermal applications and documented resources, and identifying future energy development activities that will be the most beneficial to the state (USDOE 2007a).

Arizona has set a RPS of 7 percent by 2017 and 15 percent by 2025 (60 percent of which will come from solar and 30 percent of which will be distributed energy). The RPS for geothermal electrical and geothermal heat pumps is 15 percent by 2025 (Richter 2007). There is currently no state funding or incentive for geothermal development (USDOE 2007). The state has GHG reduction targets aiming for year 2000 GHG levels by 2020 and 50 percent below 2000 levels by 2040, and is considering legislation to set these targets (Camp 2007).

Land Ownership

(33,328,000 total acres)



NRCM 2008

California

Resource Geography

California has several high-potential geothermal areas, and much of the state, with the exception of the Central Valley and the far northwest corner, displays potential for geothermal resources (USDOE 2007). Twenty-five known geothermal resource areas exist in the state (CEC 2008), including north of Santa Rosa at the Geysers, in the northeastern part of the state, in the Owens Valley and eastern Sierras, in the Mojave Desert, and at the Salton Sea and Imperial Valley in southern California (CDC 2008, CEC 2008, USDOE 2007a).

ESTIMATED CAPACITY

The USGS (2008) estimates a mean probability of electrical power generation for identified geothermal resources on all lands in California during the next 30 years at 5,404 MW, with a total low-high range of 2,422 MW to 9,282 MW.

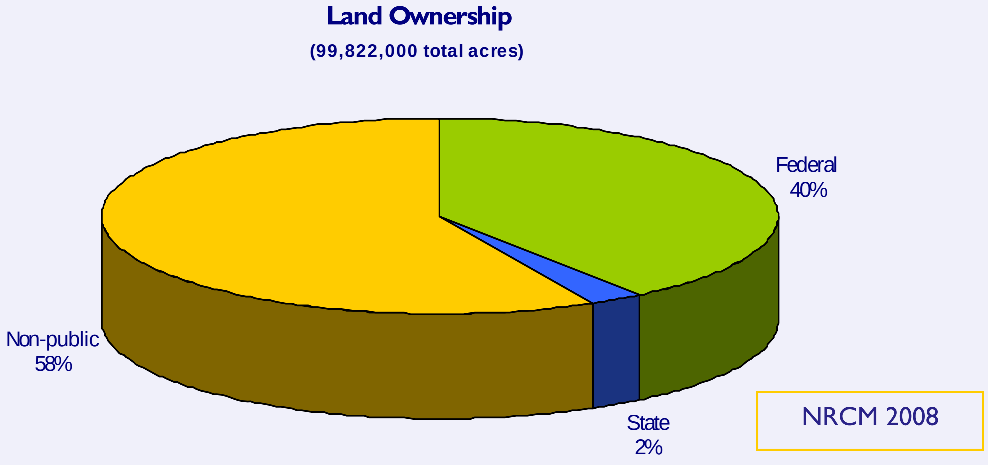
Utilization

California currently leads the nation and world in geothermal electricity generation, with seven percent of the state's total power production output coming from geothermal resources (USDOE 2007a). Six counties produce geothermal resources hot enough for electrical power generation (CDC 2008). The state has over 600 active, high-temperature geothermal wells (with fluids over 212°F, 100°C) and 230 injection wells (CEC 2008).

There are 15 electrical power projects in various stages of development in California (with a total MW potential of 921.3-969.3), and the Western Governor's Association Geothermal Task Force projects up to 2,400 MW of additional power production capacity for potential near-term development (Richter 2007). Direct use of geothermal power in California is expanding and consists of aquaculture, agriculture, recreation, and food dehydration (CDC 2008). The largest concentration of geothermal aquaculture facilities in the US is in the Imperial Valley (Rafferty 1999).

Technical Capabilities

California universities, state agencies, and private firms contribute technical capabilities to the local and national geothermal communities. The California Energy Commission maintains databases of geothermal resource information and produces numerous reports on state resources and development opportunities (USDOE 2007a).



California

California- CDC 2002. ftp://ftp.consrv.ca.gov/pub/oil/maps/Geothermal/MapS-11.pdf

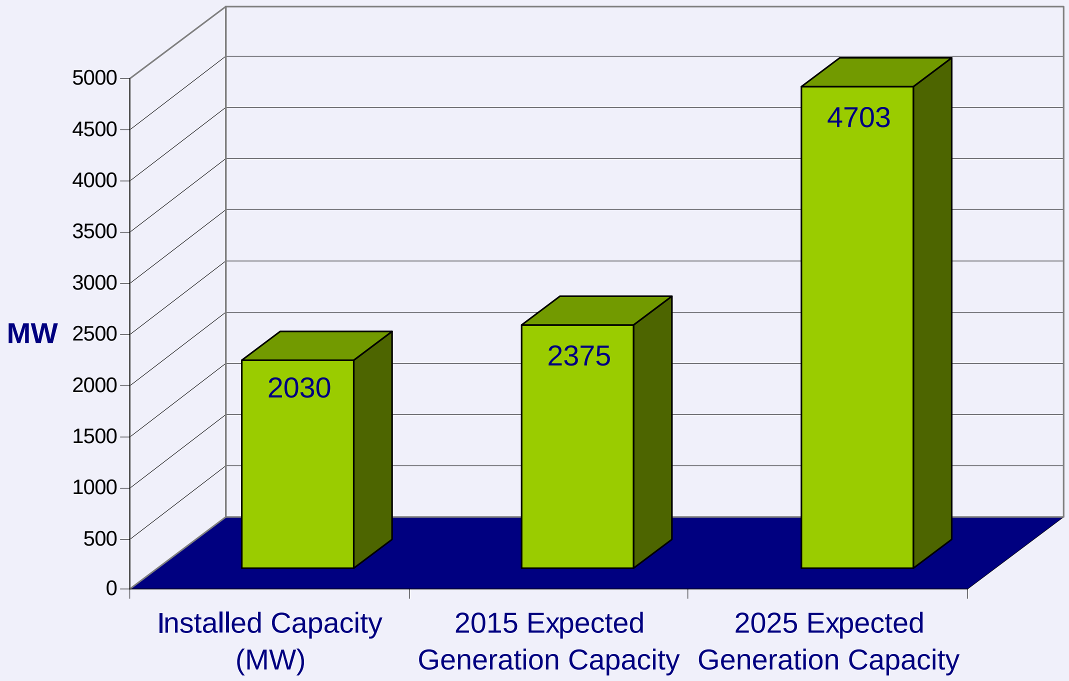
California

Electrical Power Generation and Capacity

Approximately 40 percent of total world-wide geothermal plant production takes place in California, largely due to the presence of the Geysers, a collection of 41 geothermal power plants located north of San Francisco, which is the world's largest producer of geothermal power. Additional plants are located in the Imperial Valley (east of San Diego), at Coso Hot Springs near Ridgecrest, at Amedee/Wineagle near Susanville, and at the Mammoth Lakes area in Long Valley (USDOE 2007a).

California has a literature-cited installed geothermal power capacity of 2,492.10 MW, with a current running capacity of 2030.47 MW. Approximately 14,379 GWh (gigawatt hour) of geothermal energy is produced annually from 49 plants (composed of 67 units total). These plants include binary, dry steam, single flash, double flash, dual flash, hybrid-biomass/geothermal, and dry team-low pressure reaction types (Richter 2007) and include sites at Amedee, Casa Diablo, East Mesa, Glass Mountain, Heber, Honey Lake, and Salton Sea, in addition to those previously mentioned (USDOE 2007a). The same literature cites a short-term projected geothermal electricity generation potential for the state of 2,375 MW, with a long-term potential of 4,703 MW (WGA 2006). The USGS report titled *Assessment of Moderate- and High-Temperature Geothermal Resources of the United States* estimates a mean probability of electrical power generation for identified geothermal resources on all lands in California during the next 30 years at 5,404 MW, with a total low-high range of 2,422 MW to 9,282 MW (USGS 2008). Recently, development has been limited or stalled by transmission issues and delays resulting from federal and state permitting regulations. However, geothermal power production capacity is increasing in California (Fleischmann 2007).

Geothermal Electrical Generation



WGA 2006

California

Tribal Lands

Maps and data for geothermal resources on tribal lands in California are available through the DOE tribal energy program at: http://www1.eere.energy.gov/tribalenergy/guide/geo_california.html (USDOE 2007c). The table on the following two pages indicates which tribes data is available for at the DOE website.

Tribes with Potential Geothermal Resources in California	
Agua Caliente Band of Cahuilla Indians of the Agua Caliente Indian Reservation	Alturas Indian Rancheria of Pit River Indians
Auburn Rancheria	Augustine Band of Cahuilla Mission Indians
Barona Reservation	Bear River Band of the Rohnerville Rancheria
Benton Paiute Reservation	Berry Creek Rancheria of Maidu Indians
Big Lagoon Rancheria of Smith River Indians	Big Pine Band of Owens Valley Paiute Shoshone Indians
Big Sandy Rancheria of Mono Indians	Big Valley Band of Pomo Indians of the Big Valley Rancheria
Bishop Reservation	Blue Lake Rancheria
Bridgeport Paiute Indian Colony	Buena Vista Rancheria of Me-Wuk Indians
Cabazon Band of Cahullia Mission Indians of the Cabazon Reservation	Cahuilla Band of Mission Indians of the Cahuilla Reservation
Cahto Indian Tribe of the Laytonville Rancheria	California Valley Miwok Tribe (formerly the Sheep Ranch Rancheria of Me-Wuk Indians)
Campo Band of Diegueno Mission Indians of the Campo Indian Reservation	Capitan Grande Band of Mission Indians of the Barona Reservation
Capitan Grande Band of Mission Indians of the Viejas Reservation	Cedarville Reservation of Northern Paiute Indians
Chemehuevi Indian Tribe of the Chemehuevi Reservation	Cher-Ae Heights Indian Community of the Trinidad Rancheria
Chicken Ranch Rancheria of Me-Wuk Indians	Chico Rancheria
Cloverdale Rancheria of Pomo Indians	Coast Indian Community of Yurok Indians of the Resighini Rancheria (see Resighini Rancheria)
Cold Springs Rancheria of Mono Indians	Colorado River Indian Tribes of the Colorado River Indian Reservation
Colusa Rancheria	Cortina Indian Rancheria
Coyote Valley Band of Pomo Indians	Cuyapaipe Community of Diegueno Mission Indians of the Cuyapaipe Reservation
Death Valley Timbi-Sha Shoshone Band	Dry Creek Rancheria of Pomo Indians
Elem Indian Colony of Pomo Indians of the Sulphur Bank Rancheria	Elk Valley Rancheria
Enterprise Rancheria of Maidu Indians	Fort Bidwell Indian Community of Paiute Indians
Fort Independence Indian Community of Paiute Indians	Fort Mojave Indian Tribe
Fort Yuma Indian Reservation	Greenville Rancheria of Maidu Indians
Grindstone Creek Rancheria of Wintun-Wailaki Indians	Guidiville Rancheria
Hoopa Valley Tribe	Hopland Band of Pomo Indians of the Hopland Rancheria
Inaja Cosmit Band of Diegueno Mission Indians of the Inaja and Cosmit Reservation	Jackson Rancheria of Me-Wuk Indians
Jamul Band of Mission Indians, Jamul Indian Village	Karuk Tribe
Kashia Band of Pomo Indians of the Stewarts Point Rancheria	La Jolla Band of Luiseno Mission Indians of the La Jolla Reservation
La Posta Band of Diegueno Mission Indians of the La Posta Indian Reservation	Lone Pine Paiute Shoshone Reservation
Los Coyotes Band of Cahuilla Mission Indians of the Los Coyotes Reservation	Lytton Band of Pomo Indians at the Lytton Rancheria
Manchester Band of Pomo Indians of the Manchester-Point Arena Rancheria	Manzanita Band of Diegueno Mission Indians of the Manzanita Reservation

California

Tribes with Potential Geothermal Resources in California (continued)	
Mechoopda Indian Tribe of Chico Rancheria	Mesa Grande Band of Diegueno Mission Indians of the Mesa Grande Reservation
Middletown Rancheria of Pomo Indians	Mooretown Rancheria of Maidu Indians
Morongo Band of Cahuilla Mission Indians of the Morongo Reservation	North Fork Rancheria of Mono Indians
Paiute-Shoshone Indians of the Bishop Community of the Bishop Reservation	Pala Band of Luiseno Mission Indians of the Pala Reservation
Paskenta Band of Nomlaki Indians (see Grindstone Creek Rancheria)	Pauma Band of Luiseno Mission Indians of the Pauma and Yuima Reservation
Pechanga Band of Luiseno Mission Indians of the Pechanga Reservation	Picayune Rancheria of Chukchansi Indians
Pine Community of the Lone Pine Reservation	Pinoleville Band of Pomo Indians
Pit River Tribe: XL Ranch and Likely and Lookout Rancherias Quartz Valley Indian Community of the Quartz Valley Reservation	Big Bend, Montgomery Creek, and Roaring Creek Rancherias
Ramona Band or Village of Cahuilla Mission Indians	Potter Valley Rancheria of Pomo Indians
Redwood Valley Rancheria of Pomo Indians	Quechan Tribe of the Fort Yuma Indian Reservation
Rincon Band of Luiseno Mission Indians of the Rincon Reservation	Redding Rancheria
Rohnerville Rancheria	Resighini Rancheria (formerly known as the Coast Indian Community of Yurok Indians of the Resighini Rancheria)
Rumsey Indian Rancheria of Wintun Indians	Robinson Rancheria of Pomo Indians
San Pasqual Band of Diegueno Mission Indians	Round Valley Indian Tribes of the Round Valley Reservation (formerly known as the Covelo Indian Community)
Santa Rosa Band of Cahuilla Mission Indians of the Santa Rosa Reservation	San Manuel Band of Serrano Mission Indians of the San Manuel Reservation
Santa Ysabel Band of Diegueno Mission Indians of the Santa Ysabel Reservation	Santa Rosa Indian Community of the Santa Rosa Rancheria
Sherwood Valley Rancheria of Pomo Indians	Santa Ynez Band of Chumash Mission Indians of the Santa Ynez Reservation
Smith River Rancheria	Sheep Ranch Rancheria of Me-Wuk Indians (see California Valley Miwok Tribe)
Stewarts Point Rancheria	Shingle Springs Band of Miwok Indians, Shingle Springs Rancheria (Verona Tract)
Sycuan Band of Diegueno Mission Indians	Soboba Band of Luiseno Mission Indians of the Soboba Reservation
Wiyot Tribe Table Bluff Reservation	Susanville Indian Rancheria of Paiute, Maidu, Pit River & Washoe Indians
Torres-Martinez Band of Desert Cahuilla Mission Indians	Trinidad Rancheria
Tuolumne Band of Me-Wuk Indians of the Tuolumne Rancheria	Table Mountain Rancheria
United Auburn Indian Community of the Auburn Rancheria	Tule River Indian Tribe of the Tule River Reservation
Utu Utu Gwaitu Paiute Tribe of the Benton Paiute Reservation	Twenty-Nine Palms Band of Mission Indians (Chemehuevi)
Washoe Tribe of Nevada and California of the Woodfords Community	Upper Lake Rancheria
Viejas Reservation	Yurok Tribe of the Yurok Reservation

California

Laws and Regulations

California classifies geothermal resources as Mineral and claims ownership of these resources where they occur on state-owned land; otherwise, the resource is the property of the owner of the mineral estate. Permits for siting power plants greater than or equal to 50 MW on all lands, including federal lands, are issued by the California Energy Commission. The Division of Oil, Gas, and Geothermal Resources is the lead agency for the environmental review of exploratory wells (excluding Imperial County) and permits the drilling, operation, plugging, and abandonment of all production and injection wells. The local authority is the lead agency for the environmental review of developmental wells, pipelines, and power plants generating less than 50 MW (Battocletti 2005). California has established a Geothermal State Working Group, with leadership from the California Energy Commission. The California group brings together state and regional energy professionals for workshops and other outreach activities. A geothermal industry summit was held in Sacramento in 2004, during which geothermal stakeholders examined opportunities for further development in relation to California's RPS legislation, as well as grid interconnection and industry partnership topics (USDOE 2007a).

The state's RPS requires ten percent renewable energy by 2010, with a minimum of one percent over the previous year for 2004-2010. The RPS mandates geothermal electric growth of one percent over the previous year, at least 20 percent by 2010, and a long-term goal of 33 percent by 2020 (Richter 2007). The state offers supplemental energy payments applicable to geothermal power plants through its RPS, as well as energy efficiency rebates (USDOE 2007a). In 2006 California passed a GHG law setting reduction targets of 1990 levels by 2020 and 80 percent below 1990 levels by 2050. The state requires a performance standard for electricity generation and sales of 1,100 lbs of CO_2 per MWh (Camp 2007).

Colorado

Resource Geography

Expert opinion suggests Colorado has a large geothermal resource base, although development in the state has been limited to direct-use applications (USDOE 2007a). When last inventoried in 1993, Colorado had 59 sites with water temperatures above 95° F (35° C) and 34 geothermal wells (CGS 2007). High-temperature resources exist at greater depth beneath most of the mountainous regions of the state (CGS 2007, CSWG 2007, USDOE 2007a). From preliminary heat flow and geothermal gradient maps, several areas can be identified that have potential for geothermal power generation. These locations include the Mt. Princeton area near Buena Vista, the Waunita Hot Springs area in southeast Gunnison County, the San Luis Basin especially along its margins, the San Juan Mountains near Ouray and Rico, Pagosa Springs, the Raton Basin west of Trinidad, and possibly an area near Somerset. Also, past geothermal and geochemistry studies at hot springs in the Steamboat Springs area indicate geothermal resources at depth may have temperatures above 250° F (121° C). Oil and gas development has also indicated geothermal resource potential in both the Denver and San Juan Basins (CSWG 2007).

Utilization

Geothermal electric power has not historically been considered competitive given low energy prices in the state. Thus further exploration and analysis is needed to characterize known geothermal prospects and determine what would be needed for development. As suggested above, some resources may require deep drilling, while small power units similar to the plant at Chena Hot Springs in Alaska may be applicable in some locations (Fleischmann 2007). Current plans for development continue to focus on direct-use, particularly for recreation, therapeutic properties and aquaculture. Several unique aquaculture-related projects are currently in operation, i.e. alligator farms (Clutter 2001).

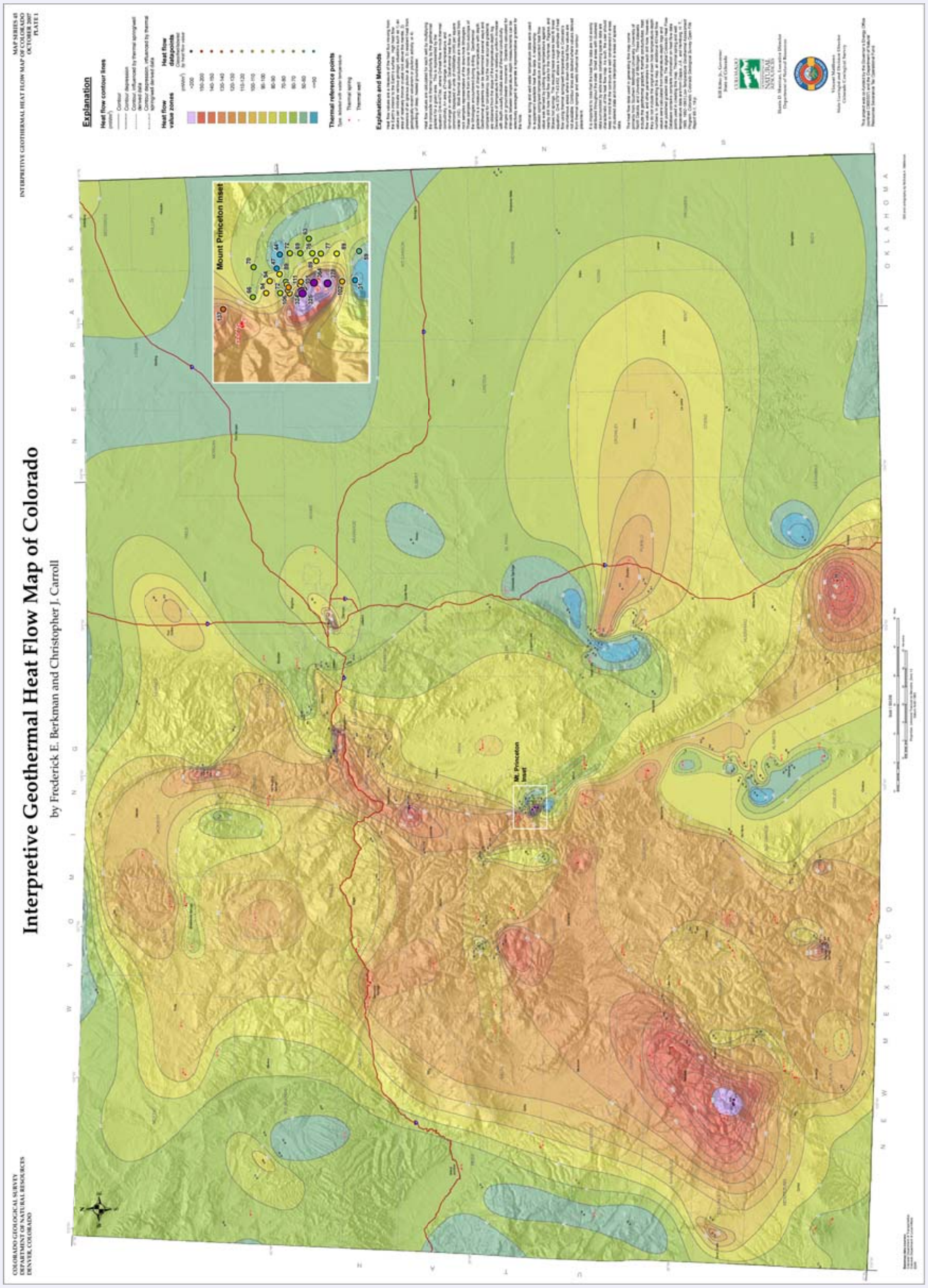
ESTIMATED CAPACITY

The USGS (2008) estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Colorado during the next 30 years at 30 MW, with a total low-high range of 8 MW to 67 MW.

Technical Capabilities

Colorado universities, state agencies, and private firms contribute technical capabilities to the local and national geothermal communities. The Colorado Geological Survey has conducted and published various assessments of the state's geothermal resource base, while the National Renewable Energy Laboratory in Golden, Colorado is the nation's leading institution for the research and development of renewable energy technologies, including geothermal energy (USDOE 2007a). Currently the Colorado Geological Survey is compiling a Colorado-specific geothermal database, which will be used to create an updated and more detailed state-wide heat flow map and geothermal gradient map (CSWG 2007).

Colorado



CGS 2007b, http://geosurvey.state.co.us/Default.aspx?tabid=484

Colorado

Technical Capabilities

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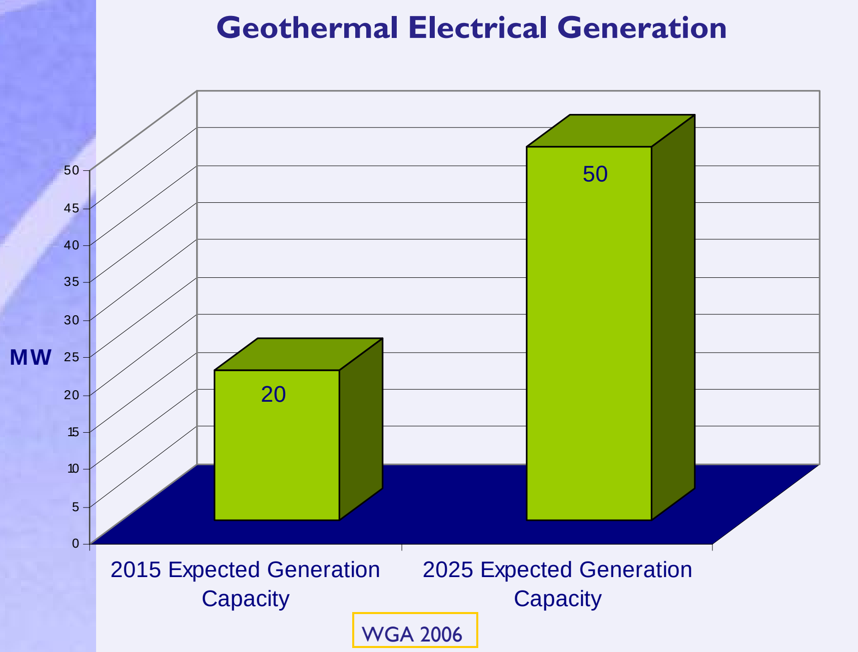
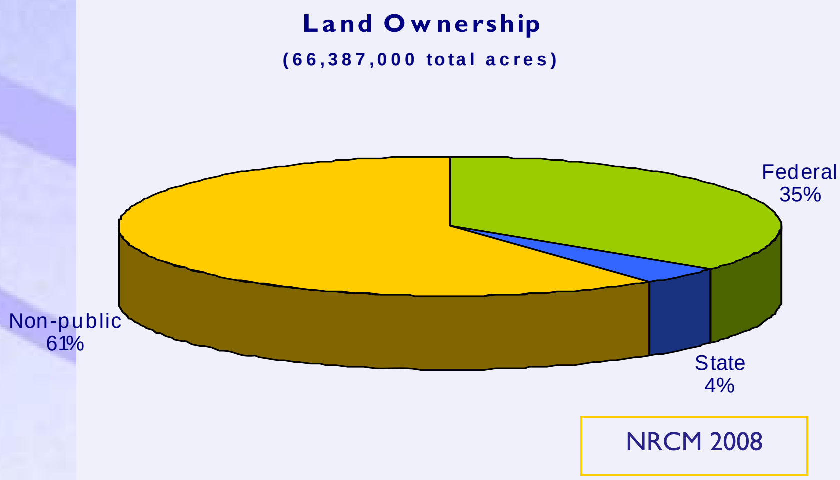




Electrical Power Generation and Capacity

No geothermal power plants are currently proposed for the state, but literature cites a short-term geothermal potential of 20 MW, with a long-term potential of 50 MW (WGA 2006). The USGS report titled *Assessment of Moderate- and High-Temperature Geothermal Resources of the United States* estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Colorado during the next 30 years at 30 MW, with a total low-high range of 8 MW to 67 MW (USGS 2008). The Colorado Geological Survey reports that the state displays a number of criteria for geothermal power potential, including quarternary volcanoes and fault lines, and one of the highest high flows in the US. Studies indicate that Colorado may have some of the best high-temperature resources in the country for extraction via "enhanced geothermal system" or "hot dry-rock" technology (CGS 2007). (A hot dry-rock resource is deep, hot crystalline rock that can be used to generate geothermal energy by pumping water down to the rock and thus heating it before it returns to the surface) (Battocletti 2005).

Colorado

Tribal Lands

Maps and data for geothermal resources on tribal lands in Colorado are available through the DOE tribal energy program at: http://www1.eere.energy.gov/tribalenergy/guide/geo_colorado.html (USDOE 2007d). Tribes for which information is available are listed below.

Tribes with Potential Geothermal Resources in Colorado
Southern Ute Indian Tribe of the Southern Ute Reservation: Main tribal lands Western-most tribal lands
Ute Mountain Tribe of the Ute Mountain Reservation

Laws and Regulations

The State of Colorado classifies geothermal resources as Water and stipulates that geothermal resources are publicly-owned. A property right to a hot dry-rock resource is an incidence of the overlaying surface, unless several resources are transferred with the subsurface estate expressly (Battocletti 2005).

The Colorado Division of Water Resources is the lead state agency administering geothermal resource rules and regulations, as well as overseeing the permitting of injection wells. The US Environmental Protection Agency (EPA), Region 8, has primacy however, and oversees the administration of underground fluid injection wells. The state Department of Public Health and Environment's Water Quality Control Division is responsible for administering surface disposal of wastewater, including geothermal fluids (Battocletti 2005). Colorado has established a Geothermal State Working Group with leadership from Delta-Montrose Electric Association. The Colorado group is in the process of bringing together state and regional energy professionals to work together to promote the increased utilization of the state's geothermal resources (USDOE 2007a). Colorado has a RPS of 20 percent by 2020 for investor-owned utilities (IOUs) and ten percent for rural co-ops and municipality utilities (four percent solar for 2007-2010 for IOUs only) (Richter 2007). Outside of the RPS the state offers no incentives for geothermal development and no funding is available at the state level for development (USDOE 2007a). Presently Colorado has no GHG laws or legislation pending, but does participate in the National Climate Registry (Camp 2007).

Idaho

ESTIMATED CAPACITY

The USGS (2008) estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Idaho during the next 30 years at 333 MW, with a total low-high range of 81 MW to 760 MW.

Resource Geography

Idaho has both low-temperature geothermal sources for potential direct-use and high-temperature sites (concentrated in the southern part of the state) that may provide opportunities for electricity production (Crimp 2006).

Utilization

Current development focuses on community heating though construction of the state's first geothermal power generation facility, a 10-MW plant at Raft River (approximately 200 miles southeast of Boise) that was completed in January 2008 (USDOE 2007a, USGI 2008).

Past exploration and development efforts have been limited, as low energy costs and the small size of the state's population did not necessitate new sources of electric power. Thus, further exploration and characterization of Idaho's geothermal resources is needed to better define the state's resource potential (Fleischmann 2007). In addition to Raft River, three other sites are being investigated for potential electricity generation: the China Cap site in Caribou County (with a literature-estimated capacity of 100 MW), an area near Willow Springs (with a literature-estimated capacity of 100 MW) (USDOE 2007a), and a site at Crane Creek in western Idaho (with a literature-estimated value of 100-179 MW) (Neely 2007).

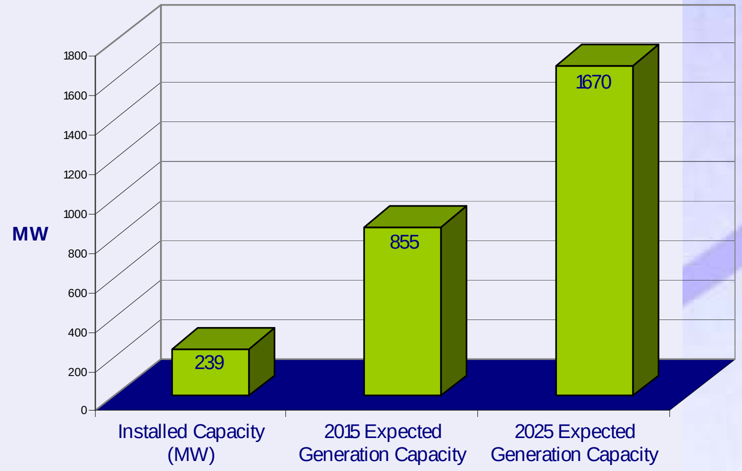
Technical Capabilities

The Idaho National Laboratory houses national expertise in the research and development of geothermal energy resources. The laboratory maintains databases of geological characteristics to aid in the characterization and development of geothermal reservoirs nationwide. Additionally, the Energy Division of the Idaho Department of Water Resources provides technical support for geothermal projects in the state and conducts educational outreach activities to promote further geothermal development (USDOE 2007a).

Electric Power Generation and Capacity

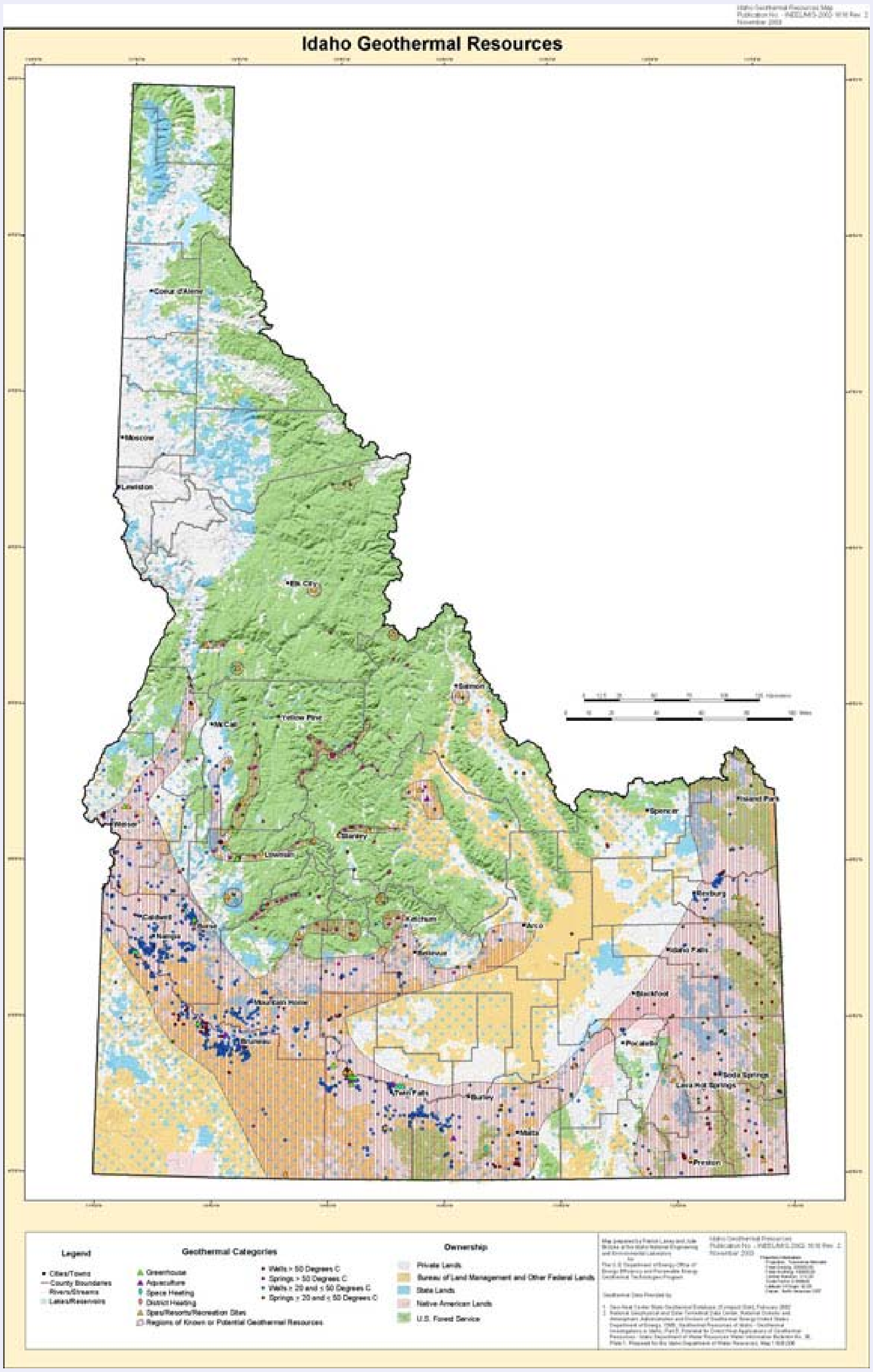
Four projects are in development, with a total literature-estimated MW potential of 39-239. Literature-cited potential energy production from geothermal resources places estimates at 855 MW short-term and 1,670 long-term (WGA 2006). The USGS report titled *Assessment of Moderate- and High-Temperature Geothermal Resources of the United States* estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Idaho during the next 30 years at 333 MW, with a total low-high range of 81 MW to 760 MW (USGS 2008).

Geothermal Electrical Generation



WGA 2006

Idaho



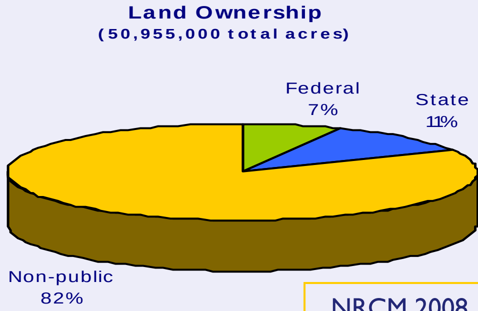
Laney, 2003c, http://geothermal.id.doe.gov/maps/id.pdf

Idaho

Tribal Lands

Tribal lands in Idaho make up roughly 1.1 percent of the state's land. The largest reservation is the Fort Hall Reservation north of Pocatello, where potential for geothermal resource development has been suggested by research in the area (Fleischmann 2007). Maps and data for geothermal resources on tribal lands in Idaho are available through the DOE tribal energy program at: http://www1.eere.energy.gov/tribalenergy/guide/geo_idaho.html (USDOE 2007e). Tribes for which information is available are listed below.

- Coeur D'Alene Tribe of the Coeur D'Alene Reservation
- Duck Valley Reservation
- Fort Hall Reservation
- Kootenai Tribe
- Nez Perce Tribe
- Shoshone-Bannock Tribes of the Fort Hall Reservation
- Shoshone-Paiute Tribes of the Duck Valley Reservation



NRCM 2008

Laws and Regulations

Idaho classifies geothermal resources as *sui generis* and Water. Groundwater with a temperature greater than or equal to 212°F at the well bottom fall under the category of *sui generis* and is further classified as a "geothermal resource." Groundwater between 85-212°F at the well bottom is classified as a "low temperature geothermal resource." The state claims ownership of all geothermal resources underlying state and school lands and holds the right to regulate development and use of all of the state's geothermal resources (Battocletti 2005).

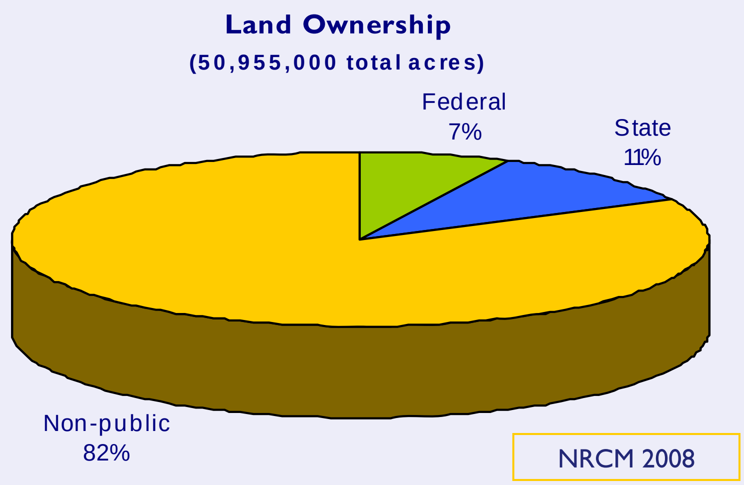
The Idaho Department of Water Resources issues water rights, well-drilling permits, and injection well permits. The state's DEQ Water Quality Division is responsible for administering surface disposal of wastewater, including geothermal fluids. The Idaho Department of Lands has a process that includes permitting, bonding, and royalties. The state does not have comprehensive environmental review statutes and does not coordinate permitting at the state level. Developers must obtain permits from state and local boards and agencies. The use of "geothermal resources" (as classified by the state) does not require a permit to appropriate water unless it will decrease groundwater in any aquifer or other groundwater resource, or measurably decrease groundwater available from prior water rights. The use of "low-temperature geothermal resources" requires a permit to appropriate water (Battocletti 2005). Idaho has established a Geothermal State Working Group, with leadership from the Idaho Energy Division. The group organizes workshops to promote the increased utilization of the state's geothermal resources (USDOE 2007a).

Idaho currently has no RES or RPS (Richter 2007) but does offer incentives for geothermal development, including low-interest loans and sales tax exemption for equipment used in construction of geothermal plants. Minimal state funding is allocated for geothermal development (most previous research has been federally funded) (USDOE 2007a). The state has no GHG laws or pending legislation. As of May 2007, the Director of the Idaho Department of Environmental Quality is, by executive order, to develop GHG reduction strategies (Camp 2007).

Montana

Resource Geography

The state of Montana has more than 50 geothermal areas and at least 15 high-temperature sites. There are seven locations with surface temperatures above 149° F (65°C), plus 20 locations with temperatures above 110°F (43° C). Low- and moderate-temperature wells and springs can be found in nearly all areas of Montana (MDEQ 2008).



The US DOE and Montana state government have joined together to organize a database of locations where geothermal resources have been identified. Records show at least 15 high-temperature sites, several with estimated deep reservoir temperatures exceeding 176.7°C. Some of these sites are located in the vicinity of Helena, Bozeman, Ennis, Butte, Boulder, and White Sulphur Springs (Fleischmann 2007, MDEQ 2008).

Utilization

While there are many areas in Montana with the potential to support geothermal electrical generation, development has thus far been limited to direct-use applications due to the proximity of previously proposed plans to Yellowstone National Park, an issue that created controversy and concern. Geothermal electrical development has also been overlooked in the past due to the state's low fossil fuel prices, small population, and lack of transmission access to remote locations (Fleischmann 2007). Current development focuses on direct-use (mostly recreational and therapeutic). One private company is currently exploring the possibility of installing a small binary plant near an existing spa (Battocletti 2005).

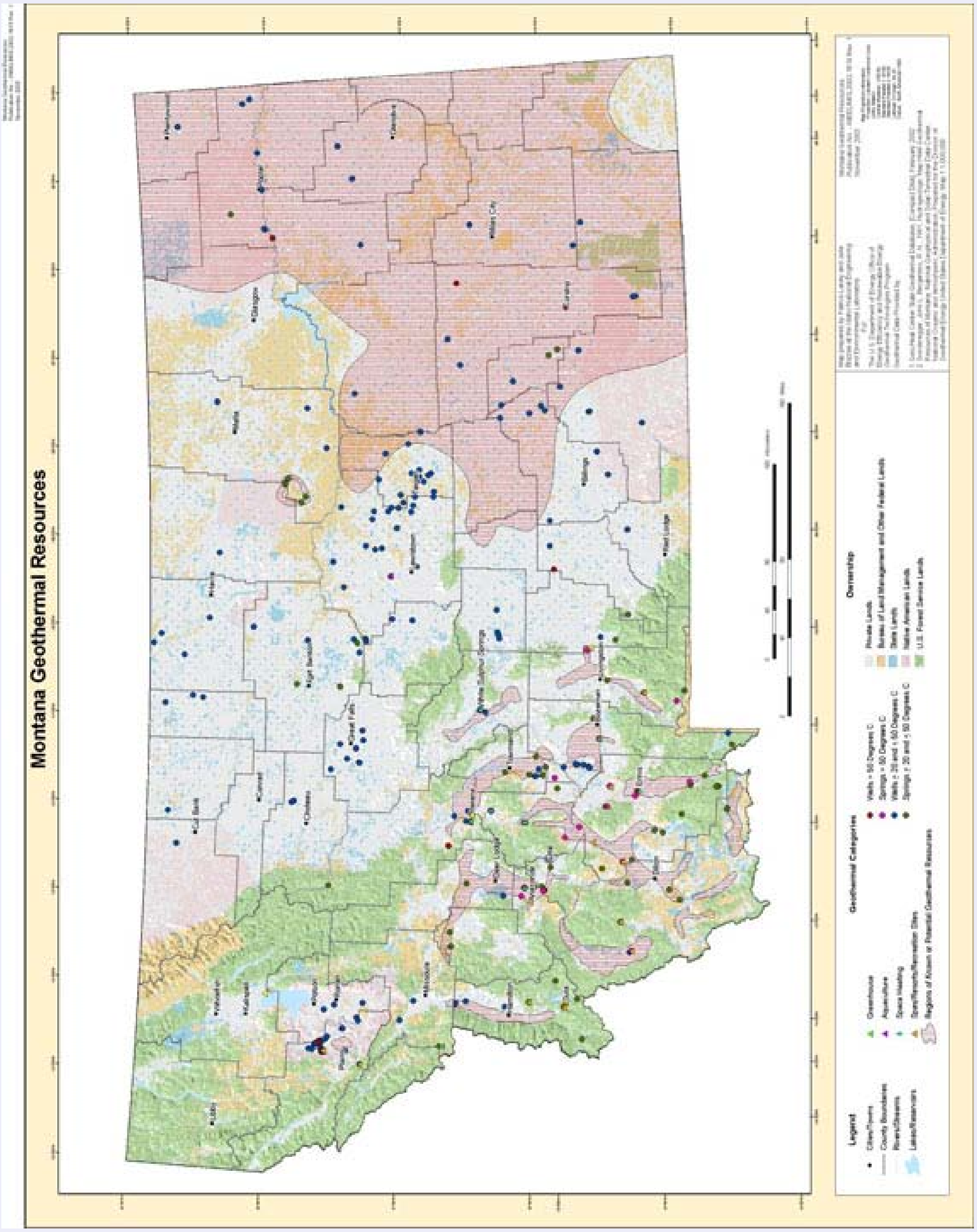
Electrical Power Generation and Capacity

There is presently no installed geothermal electric capacity in the state. The Western Governors' Association report did not identify geothermal resource potential for electrical generation in Montana, however, input for state and industry acknowledge that new technologies and undiscovered resources may yield geothermal resources that are viable for electrical generation in the future. A recent study regarding deep oil wells at Poplar Dome Oil Field (located on the Fort Peck Indian Reservation in northeast Montana) indicated potential for generating one MW from producing oil wells or three MW by deepening and hydrofracturing unused wells. This area currently produces 20,000 barrels per day of water at 130°C and there is interest in the possibility of the area supporting small geothermal power plants (USDOE 2007a). The USGS report titled *Assessment of Moderate- and High-Temperature Geothermal Resources of the United States* estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Montana during the next 30 years at 59 MW, with a total low-high range of 15 MW to 130 MW (USGS 2008).

ESTIMATED CAPACITY

The USGS (2008) estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Montana during the next 30 years at 59 MW, with a total low-high range of 15 MW to 130 MW.

Montana



Laney, 2003d, http://geothermal.id.doe.gov/maps.mt.pdf

Montana

Maps and data for geothermal resources on tribal lands in Montana are available through the DOE tribal energy program at: http://www1.eere.energy.gov/tribalenergy/guide/geo_montatna.html

Tribes with Potential Geothermal Resources in Montana
Assiniboine and Sioux Tribes of the Fort Peck Indian Reservation: Eastern lands Western lands
Blackfeet Tribe of the Blackfeet Indian Reservation
Chippewa-Cree Indians of the Rocky Boy's Reservation
Confederated Salish & Kootenai Tribes of the Flathead Reservation
Crow Tribe: Main tribal lands Easternmost lands
Flathead Reservation
Fort Belknap Reservation
Fort Peck Indian Reservation: Eastern lands Western lands
Gros Ventre & Assiniboine Tribes of the Fort Belknap Reservation
Northern Cheyenne Tribe of the Northern Cheyenne Indian Reservation
Rocky Boy's Reservation

Laws and Regulations

The state of Montana classifies geothermal resources as *sui generis* and claims ownership to geothermal resources on state lands. State water laws apply to all geothermal development involving production and diversion of geothermal fluids. Groundwater is defined by the state as a public reserve that must be appropriated (Battocletti 2005).

The Montana Department of Natural Resources and Conservation is responsible for issuing water rights and well construction permits. The US EPA, Region 8, oversees the administration of underground fluid injection. The Montana Department of Environmental Quality (DEQ) is responsible for administering surface disposal of wastewater, including geothermal fluids (Battocletti 2005). A state Geothermal Working Group is planned for Montana (USDOE 2007). The state currently has a RPS that requires IOUs to obtain 5 percent of their energy from renewable sources for years 2008-2009, 10 percent for 2010-2014, and 15 percent for 2015 and each year after (Richter 2007). Geothermal power plants are eligible for RPS incentives as well as tax credits, grants, and loans; however, no state funding is currently available specifically for geothermal development (USDOE 2007a). In May 2007, Montana passed GHG legislation prohibiting the approval of new coal generating units unless 50 percent of CO_2 emitted is captured and sequestered (Camp 2007).

Nevada

Resource Geography

High-temperature (>150°C) resources suitable for electric power production are located primarily in the northwest portion of the state, while direct-use occurs state-wide, particularly in regard to food processing plants. There are several geothermal research facilities in the state, and field investigations are ongoing to further characterize geothermal resources (NCMR 2008, USDOE 2007a).

Utilization

Nevada is second to California in levels of geothermal electricity production. Direct-use in the state consists primarily of agriculture drying and industrial applications such as mining (Lund 2003).

ESTIMATED CAPACITY

The USGS (2008) estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Nevada during the next 30 years at 1,391 MW, with a total low-high range of 515 MW to 2,551 MW.

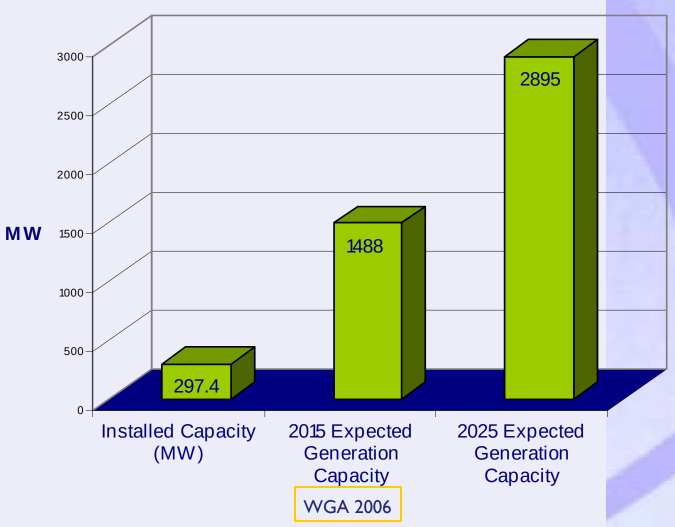
Technical Capabilities

Nevada universities, state agencies, and private firms contribute technical capabilities to the local and national geothermal communities. The Great Basin Center for Geothermal Energy, part of the University of Nevada at Reno (UNR), conducts geologic research and has produced a database of Nevada's geothermal resources to accelerate projects in the Great Basin region. Additionally, the UNR Redfield branch campus will feature a Renewable Energy Center for research and education in renewable energy systems (USDOE 2007a).

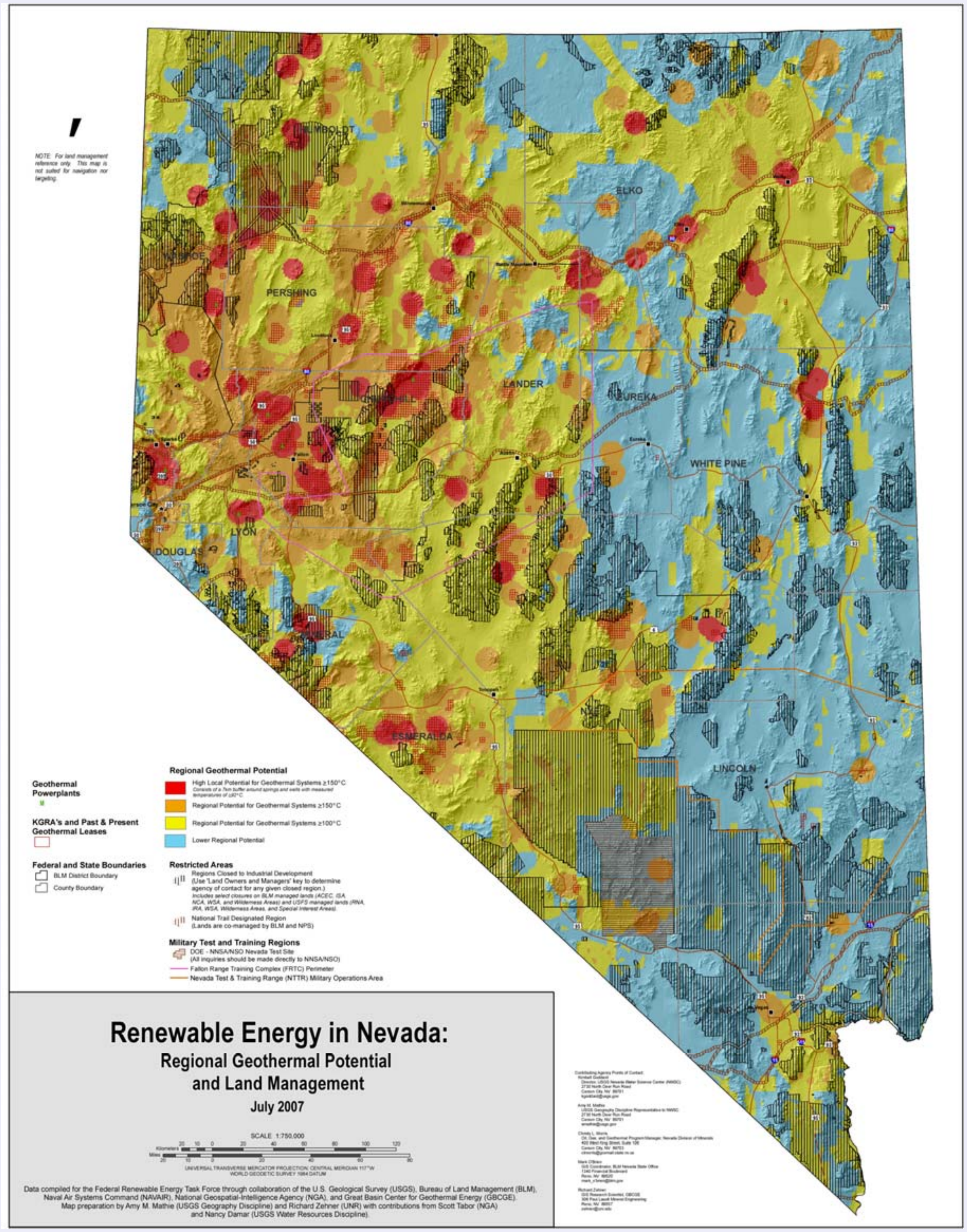
Electrical Power Generation and Capacity

There are 15 geothermal plants (totaling 40 units) in operation in the state (NCMR 2008). A 20-MW capacity plant was commissioned at Steamboat in November 2005, the first in response to the state's RPS. Literature-cited potential energy production from geothermal resources places estimates at 1,488 MW short-term and 2,895 long-term (WGA 2006). The USGS report titled *Assessment of Moderate- and High-Temperature Geothermal Resources of the United States* estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Nevada during the next 30 years at 1,391 MW, with a total low-high range of 515 MW to 2,551 MW (USGS 2008). Future plans include power generation in the Pumpernickel Valley, Stillwater, and Salt Wells areas and within Washoe, Churchill, Humboldt, and Elko Counties. Power purchase contracts have already been established with local utilities for proposed power plant construction at some locations (USDOE 2007a). Additionally, on August 5, 2008, a BLM lease sale for geothermal resources was held for lands in Churchill, Elko, Esmeralda, Humboldt, Lander, Mineral, Nye and Pershing Counties. The manner in which Nevada has combined federal and state efforts to develop geothermal resources has been very effective and could serve as a model for other states (Battocletti 2005).

Geothermal Electrical Generation



Nevada



UNR 2007, http://www.unr.edu/Geothermal/pdffiles/NV_GEOTHERM.pdf)

Nevada

Tribal Lands

Tribal lands in Nevada make up roughly 1.7 percent of the state's land. There are three tribal reservations of particular interest for geothermal development opportunities. One is the Pyramid Lake Paiute Reservation located 50 miles north of Reno, where extensive exploration has been performed and development is likely within the next few years. The others are in the Walker River Paiute Reservation and the Fallon Reservation and Colony of the Paiute-Shoshone tribe. Developers have expressed interest in geothermal projects in both reservations, although no projects have yet been proposed. However, the Fallon Reservation and Colony abuts existing geothermal power facilities at Stillwater, and tribal leaders are involved in the process for the new facility being developed there (Fleischmann 2007). Maps and data for geothermal resources on tribal lands in Nevada are available through the DOE tribal energy program at: http://www1.eere.energy.gov/tribalenergy/guide/geo_nevada.html (USDOE 2007g). Tribes for which information is available are listed below.

Tribes with Potential Geothermal Resources in Nevada
Confederated Tribes of the Goshute Reservation
Duck Valley Reservation
Duckwater Shoshone Tribe of the Duckwater Reservation
Ely Shoshone Tribe
Fallon Reservation and Colony
Fort McDermitt Paiute and Shoshone Tribes of the Fort McDermitt Indian Reservation
Fort Mojave Indian Tribe
Goshute Reservation
Las Vegas Tribe of Paiute Indians of the Las Vegas Indian Colony
Lovelock Paiute Tribe of the Lovelock Indian Colony-
Moapa Band of Paiute Indians of the Moapa River Indian Reservation
Paiute-Shoshone Tribe of the Fallon Reservation and Colony
Pyramid Lake Paiute Tribe of the Pyramid Lake Reservation
Reno-Sparks Indian Colony
Shoshone-Paiute Tribes of the Duck Valley Reservation
Summit Lake Paiute Tribe
Te-Moak Tribes of Western Shoshone Indians: Battle Mountain Band South Fork Band Elko Band Wells Band
Walker River Paiute Tribe of the Walker River Reservation
Winnemucca Indian Colony
Yerington Paiute Tribe of the Yerington Colony and Campbell Ranch
Yomba Shoshone Tribe of the Yomba Reservation
Washoe Tribe of Nevada and California: Carson Colony Dresslerville Community Stewart Community

Nevada

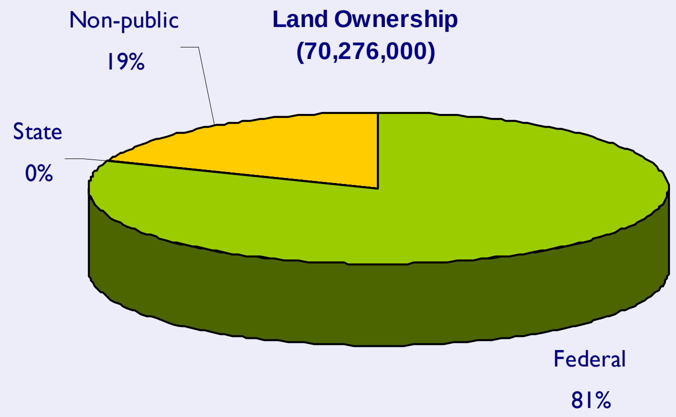
Laws and Regulations

Nevada classifies geothermal resources as both Mineral and Water. Resources in the state belong to the owner of the surface estate unless they have been reserved by or conveyed to another individual (NCMR 2006, Battocletti 2005).

The state's lead geothermal regulatory agency is the Division of Minerals Commission on Mineral Resources, which issues permits to drill or operate geothermal wells. The length of the permitting process varies depending on well type, location, and the agencies involved. Permitting for a commercial or industrial well could take 45 days whether on private or federal lands. Permitting for wells on federal land by a federal agency takes a minimum of three months; however, periods of a year or more are typical. Unlike California, Idaho, and the Pacific Northwest, where a number of the best geothermal prospects are located on USFS land, most of Nevada's promising resources are on federal land managed by the BLM (Battocletti 2005).

The Nevada Department of Conservation and Natural Resources Division of Water Resources are responsible for issuing water rights. The state Department of Conservation and Natural Resources Bureau of Water Pollution Control oversees the administration of underground fluid injection wells as well as the administration of surface disposal of wastewater, including geothermal fluids. The Nevada Department of Environmental Protection administers the Clean Water and Clean Air Acts (Battocletti 2005). Nevada has established a Geothermal State Working Group, with leadership from the Nevada Division of Minerals-Oil, Gas and Geothermal Program. The Nevada group brings together state and regional energy professionals to promote the increased utilization of the state's geothermal resources (USDOE 2007a).

The state's RPS stipulates a requirement of 20 percent renewable energy by 2015 (solar being 5 percent of annual and 1 percent of total generation). The RPS for geothermal electric and hot water district heating systems recommends an increase of up to 20 percent by 2015 (Richter 2007). Nevada's geothermal development is primarily federally funded; however, the state offers the incentive of property-tax exemption for geothermal power plants (USDOE 2007a). The state has no GHG reduction targets but is considering GHG legislation (SB422) that would require power plant emissions to be below 2006 levels for 2011-2014, below 2005 levels in 2015, one percent below each of the previous years for 2016-2019, and one and a half percent below 2019 levels for 2020 (Camp 2007).



NRCM 2008

New Mexico

ESTIMATED CAPACITY

The USGS (2008) estimates a mean probability of electrical power generation for identified geothermal resources on all lands in New Mexico during the next 30 years at 170 MW, with a total low-high range of 53 MW to 343 MW.

Resource Geography

New Mexico contains abundant geothermal resources throughout a large temperature gradient (USDOE 2007a). In a recent update of the geothermal database for New Mexico, 359 discrete thermal wells and springs were identified (NMEMNRD 2007). Resources suitable for most development are concentrated in the west and north-central regions of the state, with high-temperature gradients ranging from 1.6°F to 2.5°F per 100 feet of depth (NMEM 2006). There are no geothermal power plants currently operating; however, direct-use applications are ongoing. The northwest region contains volcanic activity from the Valles Caldera in the Jemez Mountain Range (west of Los Alamos), where the only known high-temperature geothermal system in the state occurs (base temperatures in this system exceed 500°F, 260°C) (USDOE 2007a). During the 1970s and 1980s a large geothermal power project was under development in the Valles Caldera; however, regulatory and resource issues led to the cancellation of the project (demonstration projects revealed inconsistent reservoir permeability and low productivity, though drilling and testing indicated a viable potential of 20 MW) (Fleischmann 2007).

While other potential geothermal resource areas exist, limited research has been done and most areas are without apparent surface manifestations. These areas are high risk, and developers in the state may need government funding to aid with early exploration and to reduce the high investment risk associated with their development. Sites in eight counties (Doña Ana, Grant, Hidalgo, McKinley, Rio Arriba, San Miguel, Sandoval, and Valencia), have been identified as potential geothermal resources (NMEMNRD 2007). The Rio Grande Rift area, specifically near Las Cruces, also needs to be explored in greater detail (Fleischmann 2007).

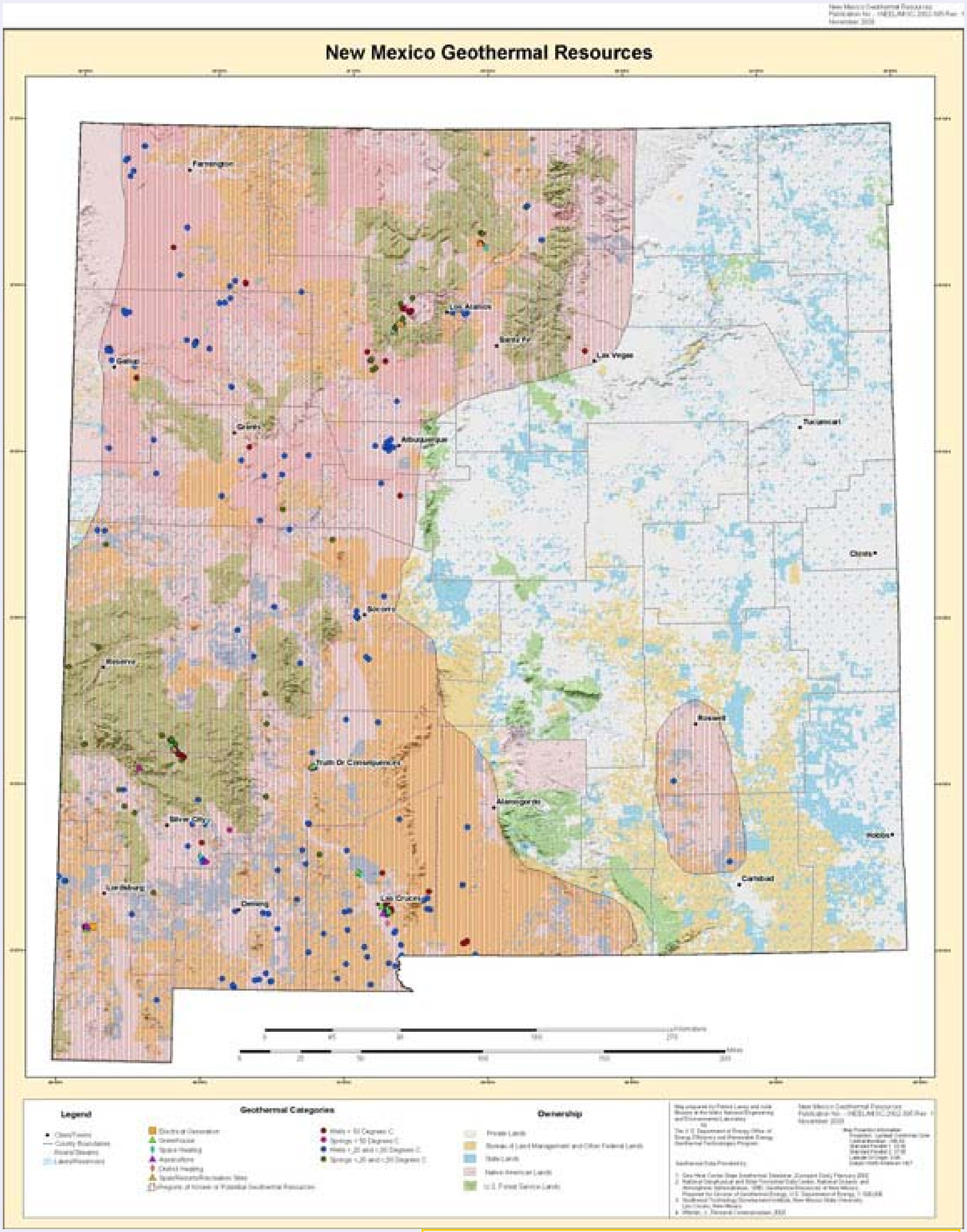
Utilization

There are no geothermal power plants operating; however, current development has included electric power production. An attempt to introduce geothermal electricity production occurred in the southwest at the Burgett Geothermal Greenhouses (near Cotton City) but was suspended due to design problems (NMEM 2006, USDOE 2007a). Drilling has occurred at two locations where small power units will be installed to provide electricity for an aquaculture facility and greenhouse. Other direct-use applications are ongoing (USDOE 2007a).

Technical Capabilities

New Mexico universities, state agencies, and private firms contribute technical capabilities to the local and national geothermal communities. New Mexico State University (NMSU) at Las Cruces conducted geothermal research that resulted in the development of a geothermal space-heating system that at one point heated up to 30 campus buildings such as dorms and athletic facilities. Sandia National Laboratory in Albuquerque is one of the three main national laboratories working on geothermal research and development (USDOE 2007a).

New Mexico

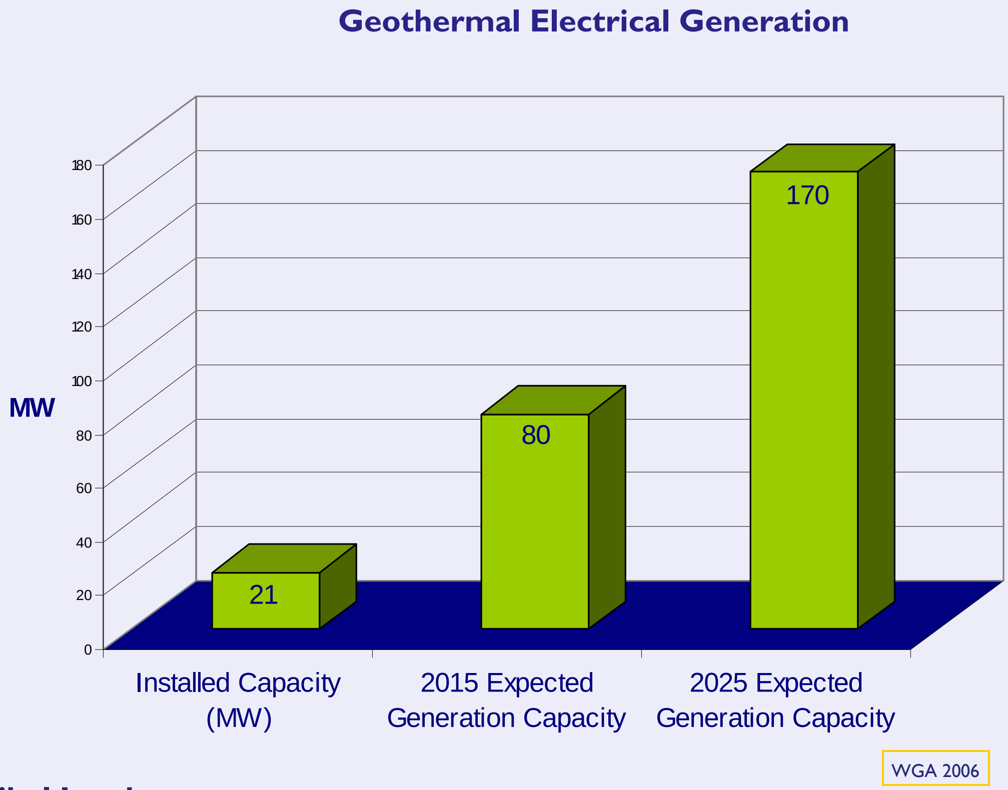


Lacey, 2003e, http://geothermal.id.doe.gov/maps/nm.pdf

New Mexico

Electrical Power Generation and Capacity

In the near term, development is likely for small-scale power. The state has two projects in development, with a total estimated potential of 21 MW. Literature estimates cite a short-term geothermal electricity generation potential of 80 MW and a long-term potential of 170 MW (WGA 2006). The USGS report titled *Assessment of Moderate- and High-Temperature Geothermal Resources of the United States* estimates a mean probability of electrical power generation for identified geothermal resources on all lands in New Mexico during the next 30 years at 170 MW, with a total low-high range of 53 MW to 343 MW (USGS 2008).



Tribal Lands

Tribal lands in New Mexico make up roughly 8.4 percent of its total acreage, and several locations on tribal reservations have been identified as having potential for geothermal development. This includes tribal lands in the San Juan Basin of northwest New Mexico, where considerable oil and gas drilling has occurred and intermediate-temperature fluid has been encountered. Another potential area is in the Jemez Mountains (in the vicinity of Valles Caldera). From 2002-2004, the Pueblo of Jemez worked with USDOE, who cost-shared a feasibility study to install a geothermal direct-use heating facility. The study concluded that there were business opportunities related to geothermal resources, but further drilling is needed before these applications can be developed on the site (Fleischmann 2007). Maps and data for geothermal resources on tribal lands in New Mexico are available through the DOE tribal energy program at: http://www1.eere.energy.gov/tribalenergy/guide/geo_newmexico.html (USDOE 2007h). Tribes for which information is available are listed on the following page.

New Mexico

Tribes with Potential Geothermal Resources in New Mexico
Jicarilla Apache Tribe of the Jicarilla Apache Indian Reservation
Mescalero Apache
Navajo Nation: Northwestern lands in New Mexico Northeastern lands in New Mexico Southwestern lands in New Mexico Southeastern lands in New Mexico Alamo Navajo Chapter Canoncito (Tohajiileeh) Chapter Ramah Navajo Chapter
Pueblo of Acoma
Pueblo of Cochiti
Pueblo of Isleta
Pueblo of Jemez
Pueblo of Laguna
Pueblo of Nambe
Pueblo of Picuris
Pueblo of Pojoaque
Pueblo of San Felipe
Pueblo of San Ildefonso
Pueblo of San Juan
Pueblo of Sandia
Pueblo of Santa Ana
Pueblo of Santa Clara
Pueblo of Santo Domingo
Pueblo of Taos
Pueblo of Tesuque
Pueblo of Zia
Pueblo of Zuni
Ute Mountain Tribe of the Ute Mountain Reservation

New Mexico

Laws and Regulations

New Mexico classifies geothermal resources as Mineral if the fluid produced has a temperature greater than 250°F and as Water if the fluid produced has a temperature less than or equal to 250°F. The state claims ownership of geothermal resources when and where it holds the mineral rights. If the fluid produced is "mineral," the resource is under the primary jurisdiction of the Oil Conservation Division of the New Mexico Energy, Minerals, and Natural Resources Department for drilling. This agency coordinates with the US EPA, Region 8, which has authority over wastewater discharge to surface waters in the state. Both of these latter agencies, in addition to the state Environmental Department, have regulatory authority over geothermal discharge permits. The New Mexico State Land Office leases the lands of the state mineral estate (Battocletti 2005).

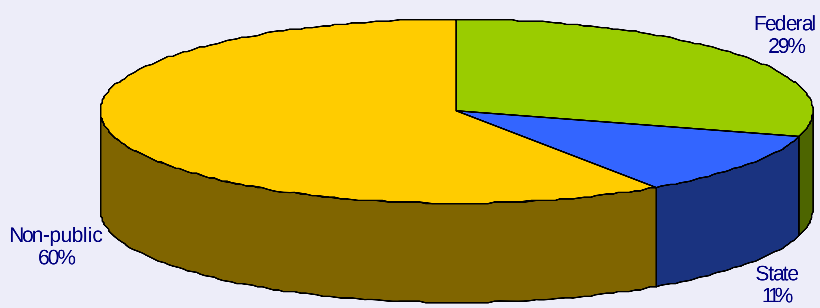
Geothermal fluid under 250°F is considered "water," and the resource is under the primary responsibility of the New Mexico Office of the State Engineer in regards to drilling and permitting. New Mexico does not have comprehensive environmental review statutes.

The state's RPS requires 20 percent renewable energy by 2020 for IOUs, 10 percent for rural co-ops and municipality utilities, with one Kilowatt (KW) of geothermal energy counting as two KW (Richter 2007). In addition to the state's RPS, geothermal resource development qualifies for the US Department of the Interior Energy Efficiency and Renewable Energy's bond program (USDOE 2007). New Mexico has established a Geothermal State Working Group, with leadership from the New Mexico Energy, Minerals, and Natural Resources Department (USDOE 2007a).

New Mexico does not have GHG laws or pending legislation; however, the state has a GHG reduction target that outlines 2000 levels by 2012, 10 percent below 2000 levels by 2020, and 75 percent below 2000 levels by 2050 (Camp 2007). There is no state funding for geothermal development. Most funding has come from the federal level from the US DOE (USDOE 2007a).

Land Ownership

(77,674,000 total acres)



NRCM 2008

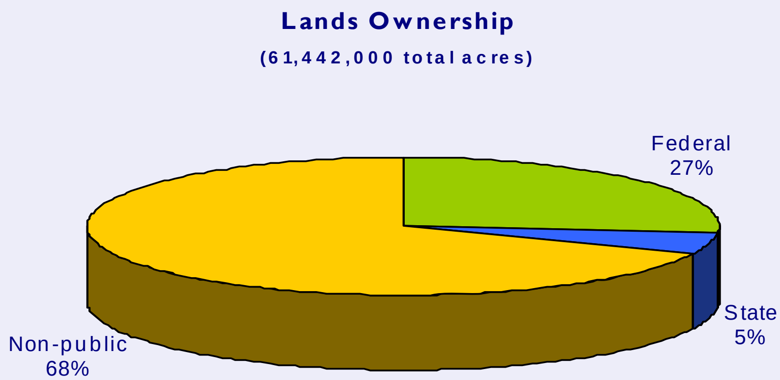
Oregon

Resource Geography

Oregon's geothermal resources are located primarily in the central and eastern regions of the state, with some activity occurring in the Cascade Range and in the southeast basin and range areas (USDOE 2007a). The state's geothermal resource base has been well documented, and numerous direct-use projects have been constructed (primarily street and building heating, and recreational and therapeutic use) (Fleischmann 2007).

Utilization

While a small-scale geothermal power plant ran in south-central Oregon in the mid 1980s, the state currently has no plants in operation (Fleischmann 2007, ODE 2008). Indirect use is being pursued, and several promising resource sites have been identified. Resources that may have significant potential for power-plant development on a small scale include Klamath Falls, Lakeview, Summer Lake, Malheur River, and Vale (ODGMI 2003, USDOE 2007a). Researchers in Oregon are experimenting with geothermal heat and power technologies for alternative fuel production, and expansions are planned for several direct-use facilities (Fleischmann 2007).



NRCM 2008

Development has and will continue to focus on direct use and further exploration of potential sites for geothermal electricity generation. While several large-scale geothermal power plants are under development, their success is contingent upon coordinated federal and state efforts to conduct EISs (Fleischmann 2007).

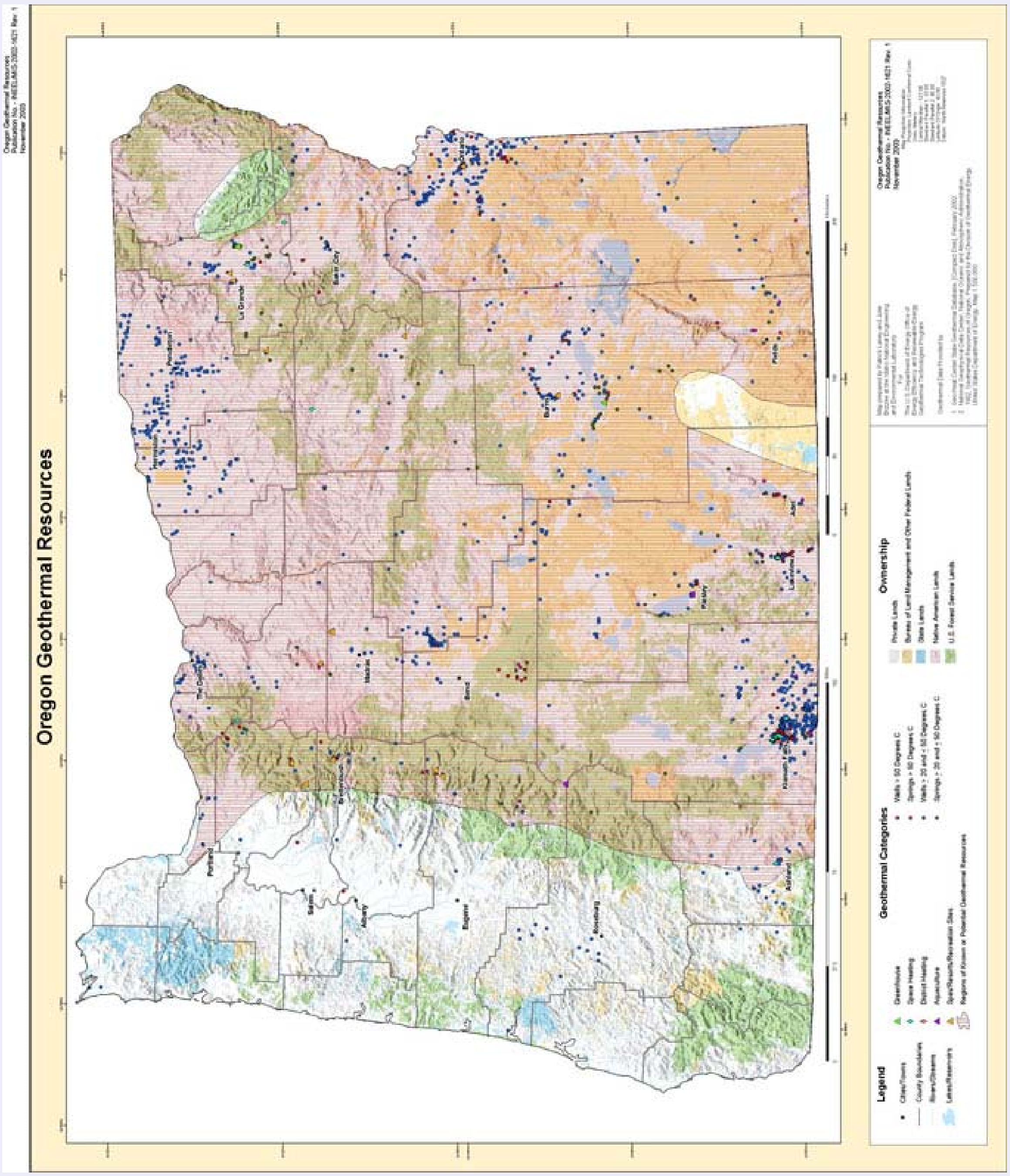
Technical Capabilities

The Oregon Institute of Technology's Klamath Falls campus houses the Geo-Heat Center, a national resource for the research and development of geothermal energy. The Geo-Heat Center aids in the transfer of technical information and provides project development support for geothermal direct-use applications (USDOE 2007a).

ESTIMATED CAPACITY

The USGS (2008) estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Oregon during the next 30 years at 540 MW, with a total low-high range of 163 MW to 1,107 MW.

Oregon



Laney, 2003f, http://geothermal.id.doe.gov/maps/or.pdf

Oregon

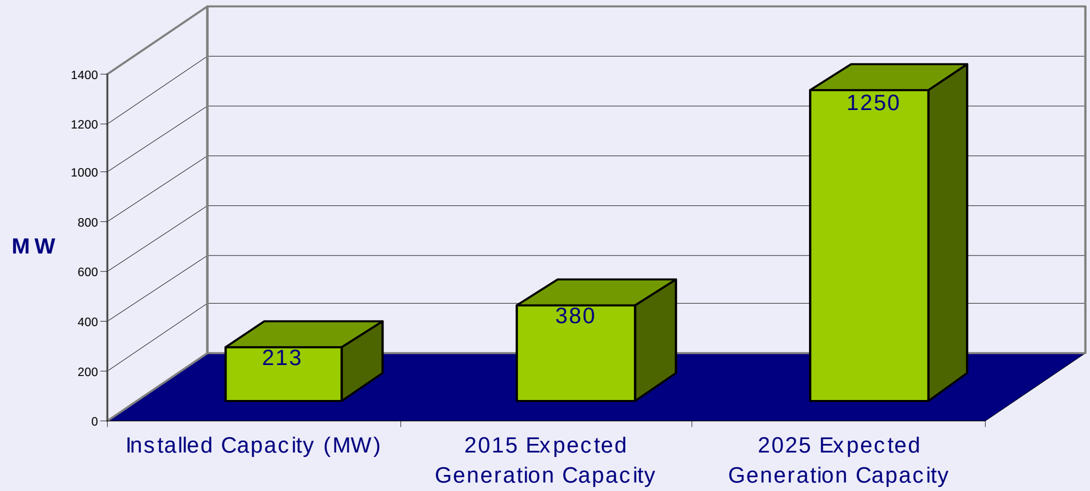
Electrical Power Generation and Capacity

There are four geothermal power plant projects in development in the state, with a total literature-estimated potential of 128.2-213.2 MW. Projected potential for the state is 380 MW in the short term and 1,250 MW in the long term (WGA 2006). The USGS report titled *Assessment of Moderate- and High-Temperature Geothermal Resources of the United States* estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Oregon during the next 30 years at 540 MW, with a total low-high range of 163 MW to 1,107 MW (USGS 2008).

Geothermal leases for the Crump Geyser site (in Warner Valley, south-central Oregon) have been secured by a private developer. Data for this site indicate temperatures in excess of 180°C, and the potential for electricity generation has been estimated at 85 MW. Research shows Newberry Volcano (near Bend in central Oregon) holds resources sufficient for a 30-MW plant that is in the initial planning stages (ODGMI 2003, USDOE 2007a). In July 2006, Davenport Power executed a 20-year power sales agreement with Pacific Gas & Electric (PG&E) involving the sale of 60-120 MW of geothermal-produced electricity from the proposed Newberry Site. The first 30-MW phase of this projected is scheduled to begin operation in 2009, with the second 30-MW phase in 2010, and the remaining 60-MW phase in 2011 (USDOE 2007a).

The main difficulties pertaining to development of geothermal power plants in this state have been a lack of transmission access and regulatory hurdles similar to those experienced in California in association with development on federal lands (Fleischmann 2007).

Geothermal Electrical Generation



WGA 2006

Oregon

Laws and Regulations

Oregon classifies geothermal resources as Mineral if the temperature of the bottom hole is greater that 250°F (121°C) and as Water if the temperature of the bottom hole is less than 250°F (121°C). The state claims ownership of all geothermal resources located on state and private land (Battocletti 2005). The Oregon DEQ is the primary agency for the disposal of water in either surface or injection well applications. Geothermal resources classified as "water" are regulated by the state Water Resources Department, while resources classified as "mineral" are regulated by the Oregon Department of Geology and Mineral Industries. The Department of State Lands issues exploration permits and drilling leases for resources on state-owned land. Oregon does not have comprehensive environmental review statutes. A developer must obtain permits directly from local land use boards (Battocletti 2005).

The state Energy Facility Siting Council (EFSC) has jurisdiction over geothermal energy facilities of 38.95 MW or greater (Battocletti 2005). The state has a RPS requiring large utilities to generate 25 percent of their power from renewable energy sources by 2025, with lesser requirements for small utilities (Richter 2007). Oregon has established a Geothermal State Working Group, with leadership from the Oregon Department of Energy, which is shared by the state of Washington (USDOE 2007a).

Incentives for geothermal development include low-interest loans, business energy tax credits, and cash incentives through the Energy Trust of Oregon resources (USDOE 2007a). The state passed GHG legislation in 2007 that requiring GHG levels be 10 percent below 1990 levels by 2020 and 75 percent below 1990 levels by 2050. Oregon has a GHG emission generation performance standard for electric generation and sales of 675 lbs CO_2 per MWh (Camp 2007).

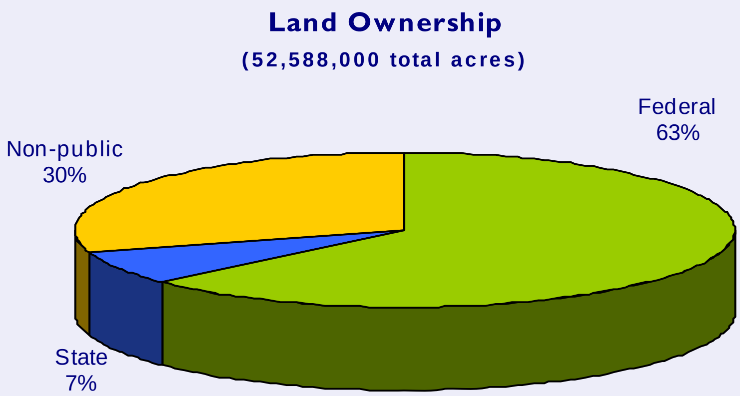
Tribes with Potential Geothermal Resources in Oregon
Burns Paiute Tribe of the Burns Paiute Indian Colony
Celilo Indian Village
Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians
Confederated Tribes of the Grand Ronde Community
Confederated Tribes of the Siletz Reservation
Confederated Tribes of the Umatilla Indian Reservation (Cayuse, Umatilla, and Walla Walla Tribes)
Confederated Tribes of the Warm Springs Reservation
Coquille Tribe
Cow Creek Band of Umpqua Indians
Fort McDermitt Paiute and Shoshone Tribes of the Fort McDermitt Indian Reservation
Grand Ronde Community
Klamath Indian Tribe-
Siletz Reservation
Umatilla Indian Reservation (Cayuse, Umatilla, and Walla Walla Tribes)
Warm Springs Reservation
Warm Springs Tribe of the Celilo Indian Village

Utah

Resource Geography

The majority of the state's renewable energy comes from geothermal sources (Nielsen 2002), which are abundant in the western and central parts of the state (UGS 2008). Geothermal resources range from low to high temperature (above 150°C). The majority of the systems suitable for power production are located within the Sevier thermal area, a region of southwest Utah covering a portion of the eastern Basin and Range Physiographic Province, and part of the Basin and Range-Colorado Plateau transition zone (Harja 2007, UGS 2008).

Research indicates that geothermal resources underlie much of the Wasatch Front, where a large portion of the state's population resides (Fleischmann 2007). Known high-temperature systems include the Roosevelt KGRA and the Cove Fort-Sulphuredale KGRA (USGS 2008). Literature from state offices suggests several known resource areas for potential development, including Abraham (Crater Springs) Hot Springs area, the Meadow-Hatton area, Joseph Hot Springs, and the Newcastle, Monroe-Red Hill, and Thermo Hot Springs areas. Other areas with development potential that have been previously investigated but lacked identified resources include the Drum Mountains-Whirlwind Valley area (near the Millard-Juab County line) and the Beryl area in western Iron County. The same office suggests the need for further exploration of the west side of Black Rock Desert in Millard County, where bottom hole temperatures of 380°F (193°C) were measured during exploratory oil and gas well drilling in 1980 (Harja 2007), as well as the Escalante Desert (UGS 2008).



NRCM 2008

Utilization

The potential extent of Utah's geothermal resources is not well understood, and the geology of the resources is complicated in some areas. Lack of transmission capacity may hinder development for indirect use in some areas; however, direct use is diverse and ongoing throughout the state (Fleischmann 2007).

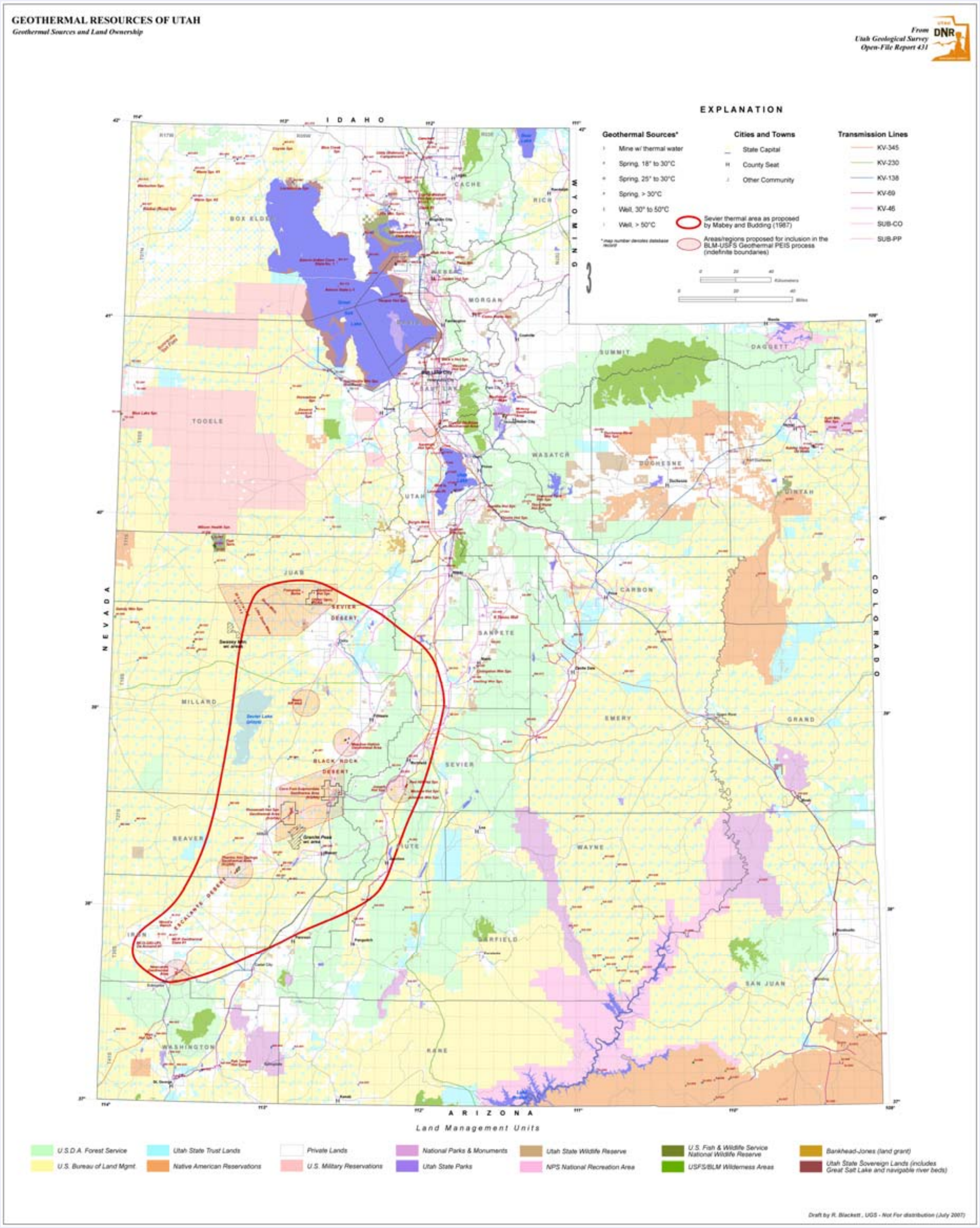
Technical Capabilities

Utah universities, state agencies, and private firms contribute technical capabilities to the local and national geothermal communities. The Utah Geological Survey maintains a database of geothermal resource information to support development projects.

ESTIMATED CAPACITY

The USGS (2008) estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Utah during the next 30 years at 184 MW, with a total low-high range of 82 MW to 321 MW.

Utah



Mabey, D.R. and K.E. Budding, 1987

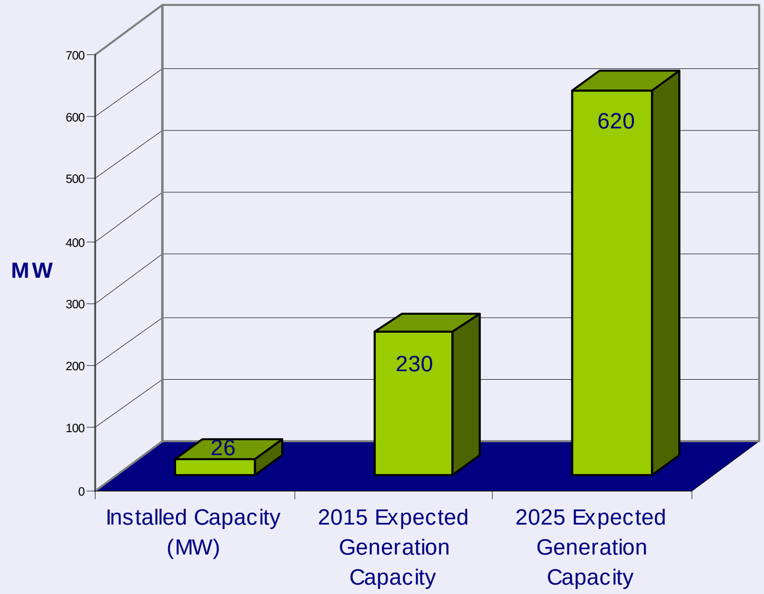
Utah

Electrical Power Generation and Capacity

Utah (along with California and Nevada) is one of the few states in the region to have developed geothermal power plants. The state has three geothermal power plants (one running, two decommissioned). Types of plant include binary, single flash , and dry steam. Current geothermal electrical output is 26 MW, with a literature-projected potential of 48-183 MW (including MW projections for two projects in development). Short-term potential is cited as 230 MW, with 620 MW long term (WGA 2006). The USGS report titled *Assessment of Moderate- and High-Temperature Geothermal Resources of the United States* estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Utah during the next 30 years at 184 MW, with a total low-high range of 82 MW to 321 MW (USGS 2008).

The state's first geothermal power plant (the Blundell geothermal plant) came online at Roosevelt Hot Springs (in Beaver County) in 1984 and has remained online since. While it currently produces 26 MW gross power, expansion has been planned that will add approximately 33 MW contingent on the resource. On April 17, 2008 a rig test was conducted and the results were encouraging. Two other facilities were built at Cove Fort-Sulphurdale KGRA (in Beaver County) during the same time period, with a total capacity of 12 MW (UGWG 2005, USDOE 2007a). While these plants were decommissioned in 2003, new owners (ENEL North America) have been successful in obtaining additional federal geothermal leases within the KGRA (Harja 2007).

Geothermal Electrical Generation



WGA 2006

Utah

Tribal Lands

Tribal land covers roughly 4.4 percent of Utah's land. The largest section of this land is located in the southeast, as part of the Navajo nation. Significant geothermal potential has not been indicated in this area; however, there are several Paiute reservations near Cove Fort and Roosevelt Hot Springs, as well as tribal land in southwestern Utah, that may be promising for geothermal development. The site of the Renaissance project is near tribal land, and the developer is working with the Northwestern Shoshoni Tribe on the project (Fleischmann 2007). Maps and data for geothermal resources on tribal lands in Utah are available through the DOE tribal energy program at: http://www1.eere.energy.gov/tribalenergy/guide/geo_Utah.html (USDOE 2007j). Tribes for which information is available are listed below.

Tribes with Potential Geothermal Resources in Utah
Confederated Tribes of the Goshute Reservation
Goshute Reservation
Navajo Nation: Four Corners region lands North central Arizona and central Utah lands
Northern Ute Indian Tribe of the Uintah and Ouray Reservation: Eastern lands Western lands
Northwestern Band of Shosoni Nation
Paiute Indian Tribe of Utah: Lands in central Utah Main reservation in southwestern Utah
Skull Valley Band of Goshute Indians
Ute Mountain Tribe of the Ute Mountain Reservation

Laws and Regulations

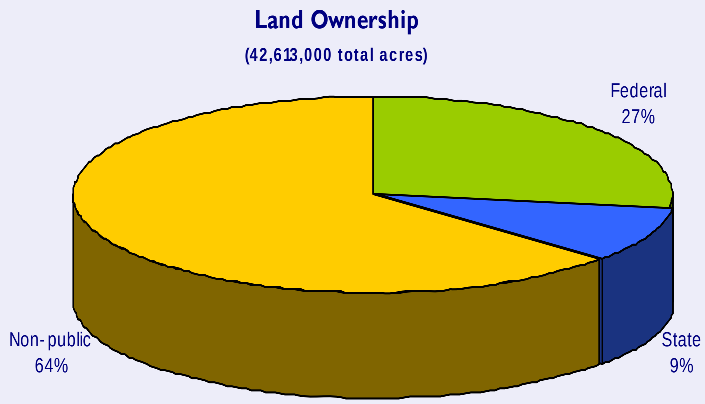
Utah classifies geothermal resources as Water. Ownership is derived from an interest in the land and not from an appropriated right to geothermal fluids. The right to a geothermal resource is based on ownership of the mineral rights or surface rights, which are usually obtained by direct ownership or leasing (Battocletti 2005).

The state Department of Natural Resources Division of Water Rights has jurisdiction and authority over all geothermal resources and issues water rights and well construction permits. The Utah Division of Water Quality oversees fluid disposal plans and permits. State regulations do not apply on tribal land, which makes up 4.4 percent of the state (Battocletti 2005). Utah does not have a comprehensive environmental review statute, nor a RES or RPS (Richter 2007). Utah has established a Geothermal State Working Group, with leadership from the Utah Geological Survey. The state does not have state funding for geothermal research or projects; however, the US DOE funds specific research. Utah offers sales-tax exemption for the purchase of leasing of equipment used to generate energy for geothermal plants resources (USDOE 2007). In August 2007, Utah developed state goals to reduce GHG emissions 15 percent by 2020 as part of its union with the Western Climate Initiative (Camp 2007).

Washington

Resource Geography

While the state has high volcanic activity, only the Cascade Range holds high potential for moderate- to high-temperature geothermal resources, particularly in the Northern Cascade Mountains (Nielsen 2002). The most recent assessment of the state's geothermal potential was completed in 1994 and identified 34 thermal springs (primarily in the Cascade Mountains) and 941 thermal wells (primarily in the Columbia Basin) (USDOE 2007a).



NRCM 2008

Utilization

Geothermal resources in Washington have been virtually undeveloped. There are no district heating systems or large buildings using the resource. There are no commercial developments such as aquaculture or greenhouses and no power plants. Resource use is currently limited to recreational and therapeutic applications (Geo-Heat 2007). Low energy prices and lack of knowledge about the state's resource base have contributed to this status (Fleischmann 2007).

Several exploration leases are pending but are associated with important scenic areas where environmental considerations could prohibit development. There are no near-term plans to develop geothermal resources in the Columbia Basin (USDOE 2007a). Near-term developments of any kind are likely to focus, at least initially, on the expansion of direct-use applications, though literature cites one geothermal power plant project in development, with a potential capacity of 50-100 MW (Richter 2007).

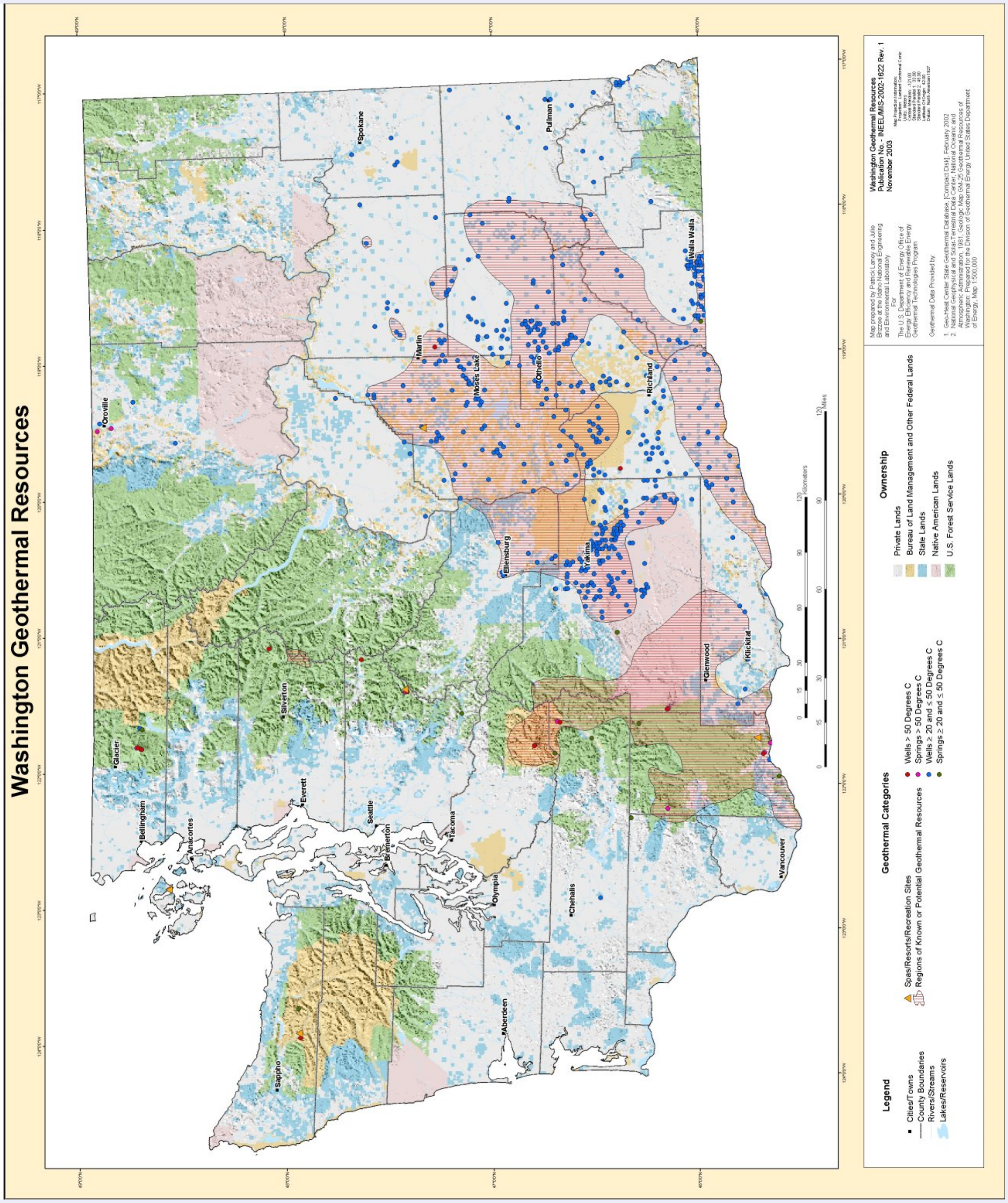
Technical Capabilities

The geothermal experts at the Washington State University Extension Energy Program have world-class expertise in high- and low-temperature geothermal energy. The group has prepared a series of guides on developing geothermal energy and a series of case studies on geothermal heat pumps (USDOE 2007a, WSUEEP 2004).

ESTIMATED CAPACITY

The USGS (2008) estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Washington during the next 30 years at 23 MW, with a total low-high range of 7 MW to 47 MW.

Washington



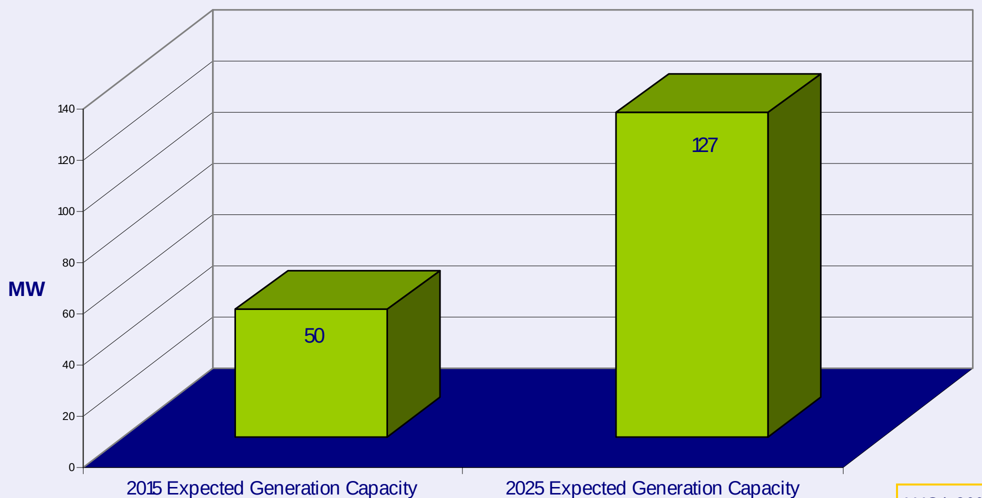
Lacy, 2003g, http://geothermal/id.doe.gov/maps.wa.pdf

Washington

Electrical Power Generation and Capacity

Potential projected geothermal electrical output is undefined, but literature estimates site a short-term projection of 50 MW, with long-term projections of 600 MW for sites at Mount Baker and Wind River in the Cascade Range (WGA 2006). The USGS report titled *Assessment of Moderate- and High-Temperature Geothermal Resources of the United States* estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Washington during the next 30 years at 23 MW, with a total low-high range of 7 MW to 47 MW (USGS 2008).

Geothermal Electrical Generation



WGA 2006

Laws and Regulations

Washington classifies geothermal resources capable of generating electricity (no specific temperature is defined) as *sui generis*. All direct-use geothermal resources are considered to be groundwater and regulated as such. The state Department of Ecology is responsible for issuing water rights, well construction permits, and fluid disposal plans, including underground injections. Developers must also secure ownership or lease rights from the Washington Department of Natural Resources Division of Lands. Environmental review is required under Washington's State Environmental Policy Act. The Washington Energy Facility Site Evaluation Council (EFSEC) determinations operate in lieu of state environmental reports and has the authority to issue permits under the Federal Clean Air Act and Clean Water Act (Battocletti 2005, http://www.energy.wsu.edu/documents/renewables/washington.pdf); however, its jurisdiction covers only plants 250 MW and greater. Washington has an RPS that requires 3 percent renewable energy by 2012 and 15 percent by 2020, with less than 5 MW capacity counting as double (Richter 2007). Geothermal development incentives for the state include eligibility under the RES and utility-run incentives. Washington has a combined Geothermal Working Group with the state of Oregon (USDOE 2007a).

In April 2007 the state passed GHG legislation (SSB6001), which mandates that GHG levels be at 1990 levels by 2020, 25 percent below 1990 levels by 2035, and less than 50 percent of 1990 levels (or 70 percent below current projected annual emissions for 2050) by 2050. Washington also has a GHG emission generation performance standard for electric generation and sales of 1,100 lbs of CO_2 per MWh (Camp 2007).

Washington

Tribal Lands

Map and data for geothermal resources on tribal lands in Washington are available through the DOE tribal energy program at: http://www1.eere.energy.gov/tribalenergy/guide/geo_Washington.html (USDOE 2007k). Tribes for which information is available are listed in table A-10 below.

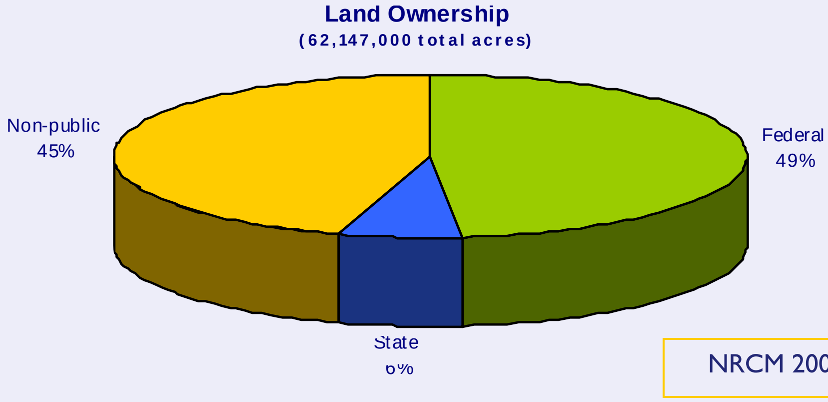
Tribes with Potential Geothermal Resources in Washington	
Colville Reservation	Chehalis Reservation
Confederated Tribes of the Colville Reservation	Confederated Tribes of the Chehalis Reservation
Hoh Indian Tribe of the Hoh Indian Reservation	Confederated Tribes and Bands of the Yakama Indian Nation
Kalispel Indian Community	Jamestown S'Klallam Tribe
Lummi Tribe of the Lummi Reservation	Lower Elwha Klallam Tribal Community
Muckleshoot Indian Tribe	Makah Indian Tribe of the Makah Indian Reservation
Nooksack Indian Tribe	Nisqually Indian Tribe of the Nisqually Reservation
Port Gamble S'Klallam Tribe	Payallup Tribe of the Puyallup Reservation
Quileute Tribe of the Quileute Reservation	Port Madison Reservation
Samish Indian Tribe	Quinault Tribe of the Quinault Reservation
Shoalwater Bay Tribe of the Shoalwater Bay Indian Reservation	Sauk-Suiattle Indian Tribe
Snoqualmie Tribe	Skokomish Indian Tribe of the Skokomish Reservation
Squaxin Island Tribe of the Squaxin Island Reservation	Spokane Tribe of the Spokane Reservation
Suquamish Indian Tribe of the Port Madison Reservation	Stillaguamish Tribe
Tulalip Tribes of the Tulalip Reservation	Swinomish Indians of the Swinomish Reservation
Yakama Indian Nation	Upper Skagit Indian Tribe

Wyoming

Resource Geography

The majority of Wyoming's geothermal resources are concentrated in the state's northwest corner, in and around Yellowstone National Park. Elsewhere, groundwater at elevated temperatures occurs beneath large areas, and research indicates that the state has a substantial geothermal resource base. High-temperature geothermal hotspots outside of environmentally sensitive areas (such as Yellowstone and the protected area of Hot Springs State Park in Thermopolis) could be suitable for electricity generation (USDOE 2007a).

One KGRA near Jackson Hole has been identified and may be capable of yielding high-temperature water (aside from Yellowstone). The possibility of volcanic and magmatic activity exists along the northern end of Jackson Hole, which may indicate geothermal reservoirs. Outside of this area it is likely geothermal development will require very deep drilling analogous to oil and gas exploration (Lyons 2003, USDOE 2007a).



NRCM 2008

Utilization

Geothermal development in the state has so far been limited to direct-use applications, specifically for recreational and therapeutic purposes. Concern and controversy surrounding the development of geothermal resources near Yellowstone National Park has precluded development of resources near Yellowstone (USDOE 2007a). Wyoming's sparse population is also a causal factor associated with limited geothermal development. Finally, most renewable energy efforts in the state have focused primarily on harnessing wind power (Fleischmann 2007).

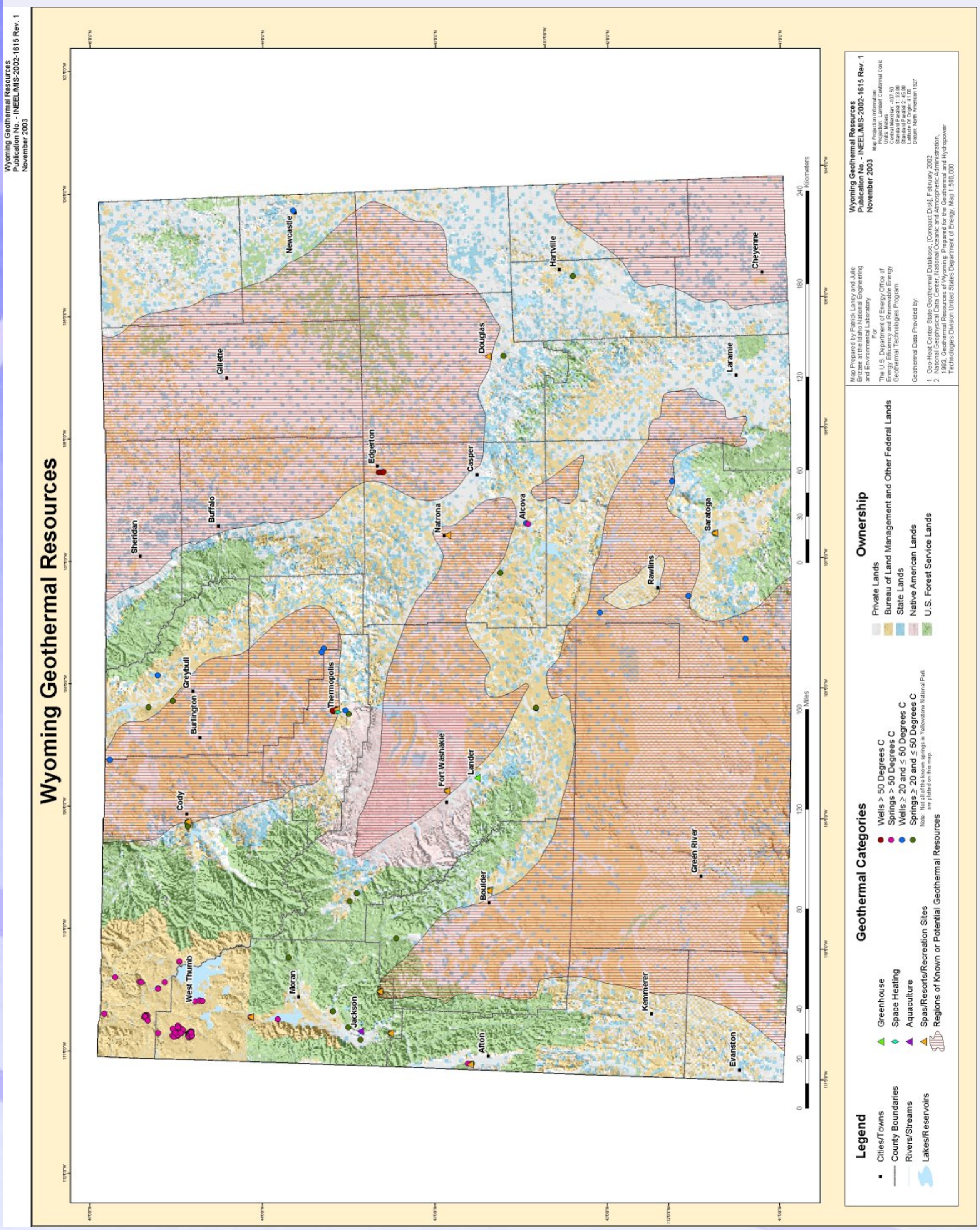
Technical Capabilities

Wyoming's coal resources are among the richest in the world, and the state possesses a wide variety of other energy sources. Renewable energy efforts are concentrated on harnessing wind energy, and little work has been done to harness Wyoming's geothermal potential. In the 1980s, studies were done for the Western Area Power Administration to evaluate the geothermal potential of resources near Thermopolis for electricity generation (USDOE 2007a).

ESTIMATED CAPACITY

The USGS (2008) estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Wyoming during the next 30 years at 39 MW, with a total low-high range of 5 MW to 100 MW.

Wyoming



Laney, 2003h, http://geothermal.id.doe.gov/maps/wy.pdf

Wyoming

Electrical Power Generation and Capacity

The Western Governors' Association report did not identify geothermal resource potential for electrical generation in Wyoming, however, input for state and industry acknowledge that new technologies and undiscovered resources may yield geothermal resources that are viable for electrical generation in the future. The USGS estimates in its report titled *Assessment of Moderate- and High-Temperature Geothermal Resources of the United States* a mean probability of electrical power generation for identified geothermal resources on all lands in Wyoming during the next 30 years at 39 MW, with a total low-high range of 5 MW to 100 MW (USGS 2008). There is interest in the potential for developing small geothermal electricity units in conjunction with oil and gas wells present in Wyoming. A demonstration project at the Teapot Dome oil field (operated by the US DOE) is under development and would install a binary unit for electrical generation and use on-site. This demonstration project, if successful, could lead to greater investment in Wyoming's geothermal resources (USDOE 2007a).

Tribal Lands

A Map and data for geothermal resources the Northern Arapaho tribe and Shoshone Tribe of the Wind river reservation in Wyoming is available through the USDOE tribal energy program at: http://www1.eere.energy.gov/tribalenergy/guide/geo_Wyoming.html (USDOE 2007l).

Laws and Regulations

Wyoming classifies geothermal resources as Water, and regulates them as a groundwater resource. Geothermal rights are a public resource and only available through appropriation. The State Engineer's Office is responsible for issuing water rights and well construction permits and is the lead agency in overseeing geothermal production wells. The state DEQ is responsible for administering surface and groundwater disposal of wastewater, including geothermal fluids (Battocletti 2005, Heasler 1985). Wyoming does not have comprehensive environmental review statutes, nor does it have a RES or RPS (Richter 2007). The state has no GHG laws or pending legislation. Wyoming has established a state Geothermal Working Group. The only incentive for geothermal development is sales-tax exemption for equipment used to generate renewable energy resources (USDOE 2007a).

Tribal Lands

Beyond those included in the aforementioned state profiles, no other geothermal projects have been developed recently on tribal lands, but there is significant potential for such development. For example, the Jemez Pueblo, the Acoma Pueblo lands west of Albuquerque, the Navajo Indian Reservation, the lands of the Jicarilla Apache tribe, and the Zia Pueblo lands have lower temperature geothermal potential. The analysis of geothermal potential relative to tribal lands deserves more attention to determine the extent to which developing these resources might involve or affect tribes. An informal analysis suggests that 57 reservations may have some potential for geothermal electricity production, representing approximately 10 percent of the American Indian population on reservations and Tribal Jurisdictional Statistical Areas (TJSAs, in Oklahoma). Another 72 reservations and TJSAs may have potential for geothermal direct-use applications (Dunley 2007).

Statutes, Policies, and Analyses

The following discussion covers the statutes and policies that may be relevant to geothermal development on tribal lands. These include the National Environmental Policy Act, the National Historic Preservation Act, the American Indian Religious Freedom Act, Executive Order 13007 on Indian Sacred Sites, the DOE policy on American Indians, and Environmental Impact Assessment analysis (Dunley 2007).

National Environmental Policy Act. The National Environmental Policy Act is an umbrella law that requires environmental reviews of federal actions, including environmental impact statements (EISs) and environmental assessments (EAs). This review process includes analysis of social impacts of the proposed actions when appropriate and may be utilized to review the social and environmental impacts of federal projects on tribal lands.

National Historic Preservation Act. The National Historic Preservation Act of 1966, amended in 1992, establishes a federal policy of encouraging preservation of cultural resources for present and future generations. The federal lead agency for a proposed action is responsible for initiating the "Section 106" review process and for consulting with the State Historic Preservation Officer and the Advisory Council on Historic Preservation. For example, in the case of several proposed Medicine Lake geothermal projects, the US Forest Service, as the Surface Managing Agency, initiated the Section 106 review process. The review included such issues as protection of Native American graves, archeological sites and resources, spiritual and vision quest sites, and paleontological resources (Dunley 2007).

American Indian Religious Freedom Act. The American Indian Religious Freedom Act of 1978 holds that federal agencies shall protect and preserve the religious freedom of American Indians. Although this issue was addressed during the Medicine Lake approval processes, the issue of spiritual values, in the public context, has still not been completely defined. More work will need to be done (Dunley 2007).

Executive Order 13007 on Indian Sacred Sites. Executive Order 13007 of 1996 (61 Federal Register 26771) provides that federal agencies are required to accommodate access to and ceremonial use of sacred sites by Indian religious practitioners, and to avoid adverse effects to sacred sites and to maintain their confidentiality. The act requires that, for any proposed action, agencies ascertain the impacts of the proposed activity on places of religious significance, sacred sites, plant species for food and healing, air quality, visual quality, noise quality, wildlife and game habitat, spiritual significance, battlegrounds, vision quest, power places, and other tribal activities such as hunting, camping, and gathering (Dunley 2007).

Tribal Lands

The Indian Development Act. The Geothermal Steam Act does not allow for BLM leasing on Indian reservations. The Indian Development Act provides that the BLM can be a technical consultant to a Native American tribe interested in negotiating with industry for development of geothermal resources at tribal lands. The BLM, if invited by the tribe, could facilitate the negotiation between the tribe and the developer (Dunley 2007).

Minerals Management Service Office of Indian Compliance and Asset Management. This office is a special organization within the Minerals Revenue Management dedicated to serving mineral-producing tribes and individual Indian mineral owners. Based in Denver, the office is a focal point for Indian mineral issues and contact with the Indian community (Dunley 2007).

American Indian and Alaska Native Tribal Government Policy, US Department of Energy. DOE first developed a policy governing its work with American Indians in 1992. The policy states that the department will identify and seek to remove impediments to working directly and effectively with tribal governments on DOE programs. Further, the policy committed DOE to consider Indian cultural issues in all its programs. Secretary Abraham has reaffirmed DOE's government-to-government policy (Dunley 2007).

Tribal Energy Self-Sufficiency Act (Draft). This bill is planned to be introduced in the Senate. Its provisions make energy projects eligible for revolving loans, loan guarantees, interest subsidies, and other incentives under the Indian Financing Act of 1974 (Dunley 2007).

Guidelines for Permitting on Tribal Lands

As sovereign nations, tribes have inherent authority over their land. Their approval must be obtained to use or lease tribal resources (e.g., land, water, and minerals). Tribes are not subject to state regulation and can negotiate with state and local governmental agencies.

Permitting on tribal land can take different paths, depending on the tribal authority provided by treaty or prescribed by constitutions developed under the Indian Reorganization Act of 1934, powers specified by Congress, and the inherent tribal authority the tribe asserts as a Sovereign Nation (Battocletti 2005).

Tribal Lands

The following are general tenets of law in Indian Country

- Federal agencies, such as the EPA, work directly with tribes on a "government to government" basis. Indian Country lands cannot be leased under the Geothermal Steam Act. They can be leased under agreements with the tribe itself or with the Indian Enterprise Corporations formed by the tribe, both with limitations on the rights granted. Often the tribes do not have commercial codes in place and cannot be sued without their permission (Battocletti 2005).

- Lands are generally (but not always) held in trust by the US and administered by the Bureau of Indian Affairs, which is generally the SMA in Indian Country when there is a third party lease or mineral management agreement (Battocletti 2005).

- Tribes can undertake exploration on their own, without BIA oversight. Even if there is no lease, there will be times in a tribally initiated project that will require working with BIA (Battocletti 2005).

- Tribes can write their own regulations or adopt the regulations of other federal, state, or local agencies. They may voluntarily relinquish sovereignty for a limited time and defined purpose to take advantage of another state, federal, or local agency's rules and oversight (Battocletti 2005).

- Tribes with appropriate regulations in place can apply for primacy over the Clean Air, Safe Drinking Water, and Clean Water Acts (Battocletti 2005).
- Projects with impacts outside of Indian Country may be subject to local and state permitting regulation (Battocletti 2005).

- Where no tribal ordinances applicable to a proposed action exist, an express federal statute allocating governmental authority over specific activities may control. Inherent tribal authority may also be preempted by a comprehensive federal regulatory scheme (Battocletti 2005).

- Tribes are not subject to NEPA unless they use funds from federal agencies such as the DOE. In some cases, BIA is the lead agency for NEPA on trust lands (Battocletti 2005).

- Where lands within Indian Country have been "allotted" to individual tribal members and then sold to non-Native Americans, another layer of jurisdictional uncertainty is created (Battocletti 2005).

- Tribes generally lack a history of natural resource development. Because of recent growing appreciation and expanded assertions of inherent sovereign powers by tribes, they may have difficulty accepting that there are jurisdictional authorities imposed by federal regulatory schemes for natural resource development on their land (Battocletti 2005).

- To determine the permitting path for a particular project, tribal sovereignty, tribal ordinances and codes, and tribal preferences must be weighed, along with other federal authorities. Tribes, consultants advising tribes, and members of industry forming contractual development agreements with tribes are urged to ensure that standard requirements for safety, health, environment, and conservation of the resource are applied to the project as would be done by responsible geothermal exploration and development projects on federal, state, and private lands, where permitting and regulatory requirements are more clearly outlined (Battocletti 2005).

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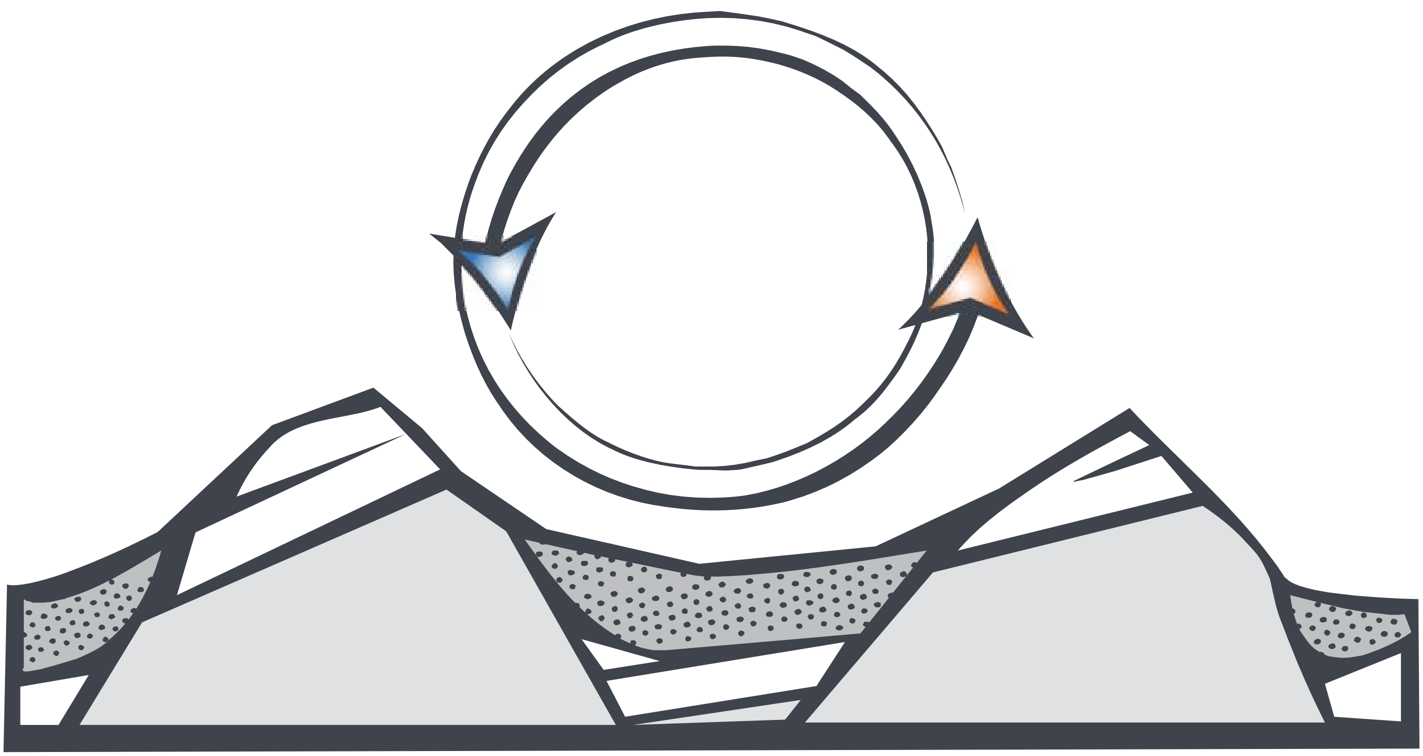

Appendix B

Memorandum of Understanding: Implementing of Section 225 of the Energy Policy Act of 2005 Regarding Geothermal Leasing and Permitting

MEMORANDUM OF UNDERSTANDING
BETWEEN
UNITED STATES DEPARTIMENT OF THE INTERIOR
AND
UNITED STATES DEPARTMENT OF AGRICULTURE

IMPLEMENTATION OF SECTION 225 OF THE ENERGY POLICY ACT OF 2005 REGARDING GEOTHERMAL LEASING AND PERMITTING

Forest Service Agreement No. 06-SU-11132428-051

I. PARTIES AND PARTICIPATING AGENCIES

A. The parties to this Memorandum of Understanding (MOU) are the United States Department of the Interior (DOI) and the United States Department of Agriculture (USDA).

B. Participating agencies include:

1. Within DOI, the Bureau of Land Management (BLM); and

2. Within USDA, the Forest Service (FS).

II. PURPOSE

The purpose of this MOU is to facilitate interagency coordination and establish policies and procedures to implement Section 225 of the Energy Policy Act of 2005, Public Law 109-58 (hereinafter the "Act"). Section 225 requires the coordination of geothermal leasing and permitting on public lands and National Forest System (NFS) lands between the Secretary of the Interior and Secretary of Agriculture.

A. The Act requires that this MOU establish:

1. An administrative procedure for processing geothermal lease applications on lands managed by the FS, including specifying lines of authority, steps in application processing and time limits for the application process;

2. A 5-year program for geothermal leasing of lands in the National Forest System with a process for updating that program every 5 years;

3. A program to reduce the backlog of all geothermal lease applications pending on January 1, 2005, by 90 percent within the 5-year period beginning on the enactment of the Act, August 8, 2005; and

4. A data retrieval system for tracking lease and permit applications.

III. AUTHORITIES

A. The primary authority for this MOU is Section 225(a) of the Energy Policy Act of 2005 (Public Law 109-58).

B. Other authorities for entering into this MOU and the roles and responsibilities that each agency will undertake are under the provisions of the Geothermal Steam Act of 1970 (84 Stat. 1566; 30 U.S.C. 1001-1025), as amended and supplemented (P.L. 109-58, Title II, Subtitle B, §225, 119 Stat. 665 (Aug. 8, 2005), the Energy Security Act, 94 Stat. 611, 42 U.S.C. § 8001 note 8854-8855), the Mineral Leasing Act of 1920, as amended (30 U.S.C. § 226-3), the National Environmental Policy Act of 1969 (83 Stat. 852; 42 U.S.C. 4321-4347), the National Forest Management Act of 1974 (90 Stat. 2949), and the Federal Land Policy and Management Act of 1976 (90 Stat. 2743, 43 U.S.C. 1701-1782.)

IV. PRINCIPLES AND GOALS

A. Principles for implementing this MOU include:

1. Participating agencies will seek improved information sharing and use, as well as an improved understanding of respective agency roles and responsibilities;
2. Development of geothermal energy is a priority for both agencies;
3. Geothermal exploration and production on Federal lands will support the Nation's increased need for energy resources; and
4. The financial resources made available through Section 234 of the Act should be used to enhance the capability to process geothermal lease applications and permit authorizations.

B. Goals for implementing this MOU include:

1. Identifying new or improved ways to increase the efficiency and minimize duplication of the geothermal leasing process;
2. Establishing interagency coordination mechanisms that can adapt to changing demands or circumstances;
3. Developing a more consistent approach among the agencies, and greater certainty in processing time requirements, to improve customer service;
4. Establishing interagency coordination mechanisms to allow for adequate flexibility to adapt to changing demands and technologies related to geothermal development;
5. Promoting responsible stewardship of Federal subsurface and surface resources through permitting actions; and

6. Developing a joint interagency data retrieval system to track application progress.

V. ROLES, RESPONSIBILITIES AND DELEGATION OF AUTHORITY

A. BLM.

1. General regulatory and management responsibilities. The BLM administers more than 261 million surface acres of public lands and 700 million acres of subsurface mineral estate (Federal land beneath surface lands owned or managed by other parties, such as the FS, National Park Service, Department of Defense and U.S. Fish and Wildlife Service).

2. Geothermal leasing. The BLM receives nominations from applicants, which may include proposed tract configurations for parcels. The BLM then forwards the proposal to the FS, which decides whether or not to consent to leasing and if so, what lease stipulations are necessary to minimize impacts to other resources and comply with regulations, policy and forest plan direction. With FS consent and once lease parcels are configured, the BLM is responsible for conducting geothermal lease sales and issuing competitive and noncompetitive leases. Although the BLM cannot issue a lease without the consent of the FS, the BLM can add any additional terms, conditions or stipulations that it deems necessary and appropriate, and must make an independent decision whether to issue the lease after review of the decision and documentation presented by the FS, and any other relevant factors.

3. Geothermal operations. If an operator proposes to conduct exploration operations on unleased FS lands, the application is submitted directly to the FS, which has the lead to conduct any necessary National Environmental Policy Act (NEPA) review and decide if the permit application should be approved and, if approved, what conditions of approval will be attached. If an operator proposes to conduct exploration operations on leased FS lands where the operator also is the lessee, the permit application is submitted to the BLM, which is the lead agency for permit review. In this case, the BLM will coordinate the NEPA review with FS, which will propose permit conditions of approval involving surface issues. The BLM will determine if the permit application should be approved and, if approved, what conditions of approval will be attached to the permit.
Subsequent to leasing, if an operator proposes to drill wells intended for production or injection or to utilize the geothermal resource (which are lease exclusive operations) on Federal lands, the BLM is responsible for review and final approval of these types of operational permit applications, after consultation with the FS. Under most circumstances, a single NEPA document will be prepared with the BLM as lead and the FS as a cooperating agency. There are situations where specific interagency agreements apply and the FS will take the lead in preparing the NEPA document.

B. FS.

1. General regulatory and management responsibilities. The FS is responsible for the surface management of 192 million acres of National Forest System (NFS) lands. The Geothermal Steam Act as amended defines the role of the FS in the management of geothermal resources.

2. The FS is responsible for consenting (or not consenting) to the leasing of NFS lands, for conducting NEPA analysis for leasing, for developing appropriate terms and conditions under which the lease may be developed, and to ensure that doing so is consistent with the Land and Resource Management Plan developed under the National Forest Management Act.

3. Subsequent to leasing, the FS cooperates with the BLM to ensure that management goals and objectives for geothermal exploration and development activities are achieved, that operations are conducted to minimize effects on surface resources, and that the lands affected by operations are reclaimed. The BLM issues and administers geothermal leases on NFS lands only after the FS has consented to leasing under appropriate terms and conditions and has taken the actions necessary for the BLM to offer available lands for lease.

4. Administrative procedure for processing lease applications. The FS authorization to implement the leasing decision is to be forwarded to the BLM within 60 days of the initial receipt by FS of the leasing proposal if it conforms to a Forest Land Management Plan and is covered by an existing leasing NEPA document. If this timeframe cannot be met, FS is to provide the BLM with an expected date of completion, along with an explanation for the delay by entering information into the joint tracking system.

VI. FIVE-YEAR PROGRAM PLAN

The FS will:

A. Coordinate with the BLM, USGS, states and other interested parties to update potential geothermal areas through existing and new resource assessments;

B. Develop a process to delineate the boundaries of geothermal potential areas (including nominated lands) that will then be prioritized for leasing decisions and the associated NEPA process;

C. Coordinate with the BLM to establish the initial 5-year NEPA schedule needed for timely leasing decisions;

D. Review the schedule as new nominations are submitted or data from interested parties changes;

E. Address the existing backlog and newly nominated lands in the first 5-year plan; and

F. Coordinate with the BLM to find supplemental funding for the program such as that provided by Section 234 of the Act to ensure timely completion.

VII. PRE-LEASE ENVIRONMENTAL DOCUMENTATION

The FS, generally, will take the lead for completing the pre-lease NEPA documents and is responsible for providing the official FS consent or non-consent to leasing on FS lands. By this MOU, FS and the BLM agree to jointly prepare NEPA documents that will meet the requirements of both agencies in reaching their independent leasing decisions. The FS and the BLM will also identify, through the analysis, reasonable and justifiable stipulations needed to protect or minimize impacts to specific resources or land uses. The BLM will also provide a "reasonably foreseeable development (RFD) scenario" if requested by the FS, to facilitate the disclosure of potential environmental impacts. The FS will transmit the consent or non-consent decision on geothermal leasing to the BLM. Appropriate offices will be involved at appropriate levels of decision making. The following will apply, however, to the extent agreed upon by both agencies under sections VII. A. and B. below:

A. Subject to the terms of future, individualized MOUs regarding geothermal resources that may be developed between particular BLM and FS offices or for a particular NEPA process, as a general matter, the BLM will:

1. Appoint a specialist to participate as a member of the FS Interdisciplinary Team in the joint preparation, and completion of the NEPA document as necessary;
2. Provide informal training on geothermal operations, their potential impacts on the environment, the effect of mitigation on operations, mitigation development, and stipulation policy, upon request and in cooperation with the FS;
3. Assist the FS in jointly scoping the issues and determining the level of NEPA document to be prepared;
4. Assist the FS in the formulation of mitigation measures and lease stipulations;
5. Ensure that the NEPA document is consistent with the BLM leasing policies and NEPA document preparation standards, so that the document can be used by both agencies to reach independent decisions, if needed;
6. Cooperate with the FS to ensure that the draft NEPA document is completed on schedule (set in Section VI. C. above);
7. Complete review and comment on the draft NEPA document within 30 working days of receipt;

8. Assist and coordinate with the FS in the review of public and agency comments, discuss and work towards agreement on proposed lease stipulations and mitigations, make necessary revisions to the draft NEPA documents and assist in preparing the draft Decision Notice (DN)/Record of Decision (ROD);

9. After an independent review, adopt the final EA/EIS and sign the DN/ROD or prepare and sign a separate BLM decision document and return the original signed documents to the FS; and

10. Issue leases with recommended special environmental stipulations or reject lease applications in accordance with the DN/ROD.

B. Subject to the terms of future, individualized MOUs regarding geothermal resources that may be developed between particular BLM and FS offices or for a particular NEPA process, as a general matter, the FS will:

1. Jointly scope the issues to be addressed in the NEPA document with the BLM, including determining the level of NEPA document to be prepared and developing a schedule for completion of the document. The goal is to complete each NEPA document within 1 to 2 years;

2. Work with the BLM to provide a RFD scenario, if needed, to be used as a basis for impact analysis in the NEPA document;

3. Request training from the BLM on post-lease geothermal operations, their potential impacts on the environment, the effect of mitigation on operations, mitigation development, and stipulation policy when determined to be necessary;

4. Prepare the NEPA document in cooperation with and with the assistance of the BLM, and

    a. Include a specialist from the BLM staff on the FS Interdisciplinary (ID) Team as necessary;

    b. Coordinate with the BLM to ensure that the NEPA document is consistent with BLM leasing and analysis policies;

5. Discuss and work toward agreement on potential mitigation measures and lease stipulations as part of alternative development with the BLM;

6. Forward a copy of the preliminary NEPA document to the BLM for review and comment within 1 week of completion;

7. Jointly review with the BLM all comments on the draft NEPA document and incorporate comments and changes as agreed;

8. Prepare the final NEPA document for public comment and review, address all public comments, prepare a DN/ROD in cooperation with the BLM and forward the final copy to the deciding officer for the FS; and

9. Transmit the leasing consent or non-consent decision, the NEPA document, and the signed FS version of the DN/ROD to the BLM within 15 calendar days after any appeals are resolved.

VIII. COMPETITIVE LEASING

The BLM is responsible for conducting geothermal lease sales and issuing competitive leases (see attached Table).

A. BLM will:

1. Coordinate and schedule an annual BLM/FS meeting to develop a proposed competitive leasing schedule, considering each agency's budgets and other work priorities;

2. Send a written request to the FS for appropriate stipulations and special terms for lease issuance at least 180 days prior to the scheduled sale date; and

3. Coordinate with the FS (lead agency) to complete the pre-lease NEPA document according to the procedures outlined in this MOU.

B. FS will:

1. Coordinate with the BLM in scheduling and holding the proposed competitive sale meeting;

2. Utilize information in mineral resource assessment in future planning documents and decisions;

3. Provide appropriate stipulations for the NFS lands involved in a proposed lease sale and special terms for lease issuance at least 90 days prior to the scheduled sale date; and

4. Coordinate with the BLM to complete the pre-lease NEPA document according to the procedures in Section VII of this MOU.

IX. NONCOMPETITIVE LEASING

The BLM is responsible for conducting geothermal lease sales and issuing noncompetitive leases (see attached Table).

A. BLM will:

1. Transmit any noncompetitive lease application package involving NFS lands to the FS within 30 days of receipt; and

2. Upon receipt of the FS consent and stipulations, make an independent decision whether to issue each lease within 30 days of conveying terms and conditions to the applicant.

B. FS will:

1. Forward land parcel lease requests from the FS to the appropriate Forest Supervisor for environmental clearance within 15 days of receipt; and

2. Complete a review of the existing NEPA document and coordinate with the BLM during the environmental review process, as outlined in Part VII. A. above, and transmit a letter of consent or no consent to the BLM within 60 days from receipt of land parcel lease requests.

C. Direct Use

Outside of the circumstances outlined in the Geothermal Steam Act of 1970, 30 U.S.C. 1003(c) as amended, by section 222 of the Act, the only lands available to be leased without a competitive sale are those in areas designated by the Secretary of the Interior for exclusive direct-use utilization of geothermal resources only pursuant to 30 U.S.C. 1003(f). Subject to forthcoming implementing regulations, such exclusive direct-use areas may have been identified and designated via attached stipulation in advance of the nomination to lease, or the designation may occur in response to the nomination to lease after appropriate reviews at the conclusion of the 90-day competitive interest notice period (30 U.S.C. 1003(f)).

X. JOINT DATA RETRIEVAL SYSTEM FOR BLM AND FS TO TRACK STATUS OF LEASE AND PERMIT APPLICATIONS

The joint data retrieval system will be completed in time to implement the forthcoming geothermal regulations being prepared to implement the geothermal provisions of the Act.

A. BLM will:

1. Provide designated FS staff with the appropriate level of access to BLM's Automated Fluid Minerals Support System (AFMSS), Legacy Rehost 2000 (LR 2000), and National Integrated Land System (NILS) transaction and reporting systems, as well as data systems used for the management of geothermal resources. Access to users will be provided within 2 weeks after submission of a request using Form 1260. Systems will be available for use 90 percent of the time within standard business operating hours using established industry metrics. The details and specifics of how the FS will access and use BLM systems will be documented in a Service Level Agreement consistent with BLM/DOI policies. FS will be able to view the status of and enter updates to transactions related to proposals on National Forest System lands, while those on the BLM lands will appear as read-only to FS users;

2. Determine infrastructure, protocols, and procedures necessary to provide secure access to joint data retrieval systems and joint geographic information system. Provide security requirements to Forest Service;

3. Assure adequate system performance and security to maintain data integrity for FS users which access the BLM's data systems used for the management of geothermal resources; and

4. Be responsible for the Information Technology management, including Project Change Management, of the BLM's data systems used for the management of geothermal resources.

B. FS will:

1. Establish infrastructure, protocols, and procedures to meet the security requirements as determined by BLM for access to joint data retrieval systems and geographic information systems by designated Forest Service staff;

2. Provide the BLM with a completed BLM Form-1260 for all FS users who need to access the BLM's data systems used for the management of geothermal resources; and

3. Use the BLM's Project Change Management Boards for requesting changes to the BLM's data systems used for the management of geothermal resources.

XI. MEASURES OF SUCCESS OR CHANGE FOR GEOTHERMAL LEASING AND PERMITTING PROGRAMS

A. <u>Success Measures.</u> Measures of success for the Geothermal Leasing and Permitting Programs include:

1. Streamlining and increasing interagency efficiency in processing geothermal leases, permits and associated agency approvals;

2. Increasing ability to more timely process and issue geothermal leases and approve permits that will withstand administrative and judicial challenge; and

3. Decreasing the lease application backlog by 90 percent in 5 years.

B. Data for Measuring Success. For Geothermal Leasing and Permitting, the following, at a minimum, will be tracked and measured:

1. The total number of nominations and permit applications received, processed, and issued;

2. The elapsed time from receipt to issuance or approval, including the time required for major steps or components; and

3. The number of applications backlogged.

C. The information identified in the preceding paragraph will be collected for 5 fiscal years after enactment of the Act and will be compared to the same parameters in each of the 3 fiscal years preceding passage of the Act.

XII. MUTUAL UNDERSTANDING AND AGREEMENT

A. <u>Freedom of Information Act (FOIA).</u> Any information furnished to the BLM and FS under this instrument is subject to the Freedom of Information Act (5 U.S.C. 552).

B. <u>Participation in similar activities.</u> This instrument in no way restricts the BLM or FS from participating in similar activities with other public or private agencies, organizations, and individuals.

C. <u>Responsibilities of Parties.</u> The BLM and FS and their respective offices will handle their own activities and utilize their own resources, including expenditures of their own funds, in pursuing these objectives, except as previously outlined. Each party will carry out its separate activities in a coordinated and mutually beneficial manner.

D. Principal Contacts

1. BLM.

Assistant Director, Minerals, Realty and Resource Protection
1849 C Street, N.W.
Washington, DC 20240
(202) 208-4201

2. FS.

   Director, Minerals and Geology Management
   1400 Independence Ave., SW
   Washington, DC 20250
   (703) 605-4791

XIII. FUNDING

A. Section 234 of the Energy Policy Act of 2005 authorizes rentals, royalties and other payments required under leases under the Geothermal Steam Act of 1970, excluding funds required to be paid to state and county governments, to be deposited in a special fund available to "…the Secretary of the Interior for expenditure, without further appropriation and without fiscal year limitation, to implement the Geothermal Steam Act of 1970 and this Act…."

B. Section 234(c) of the Energy Policy Act of 2005 authorizes the Secretary of the Interior to expend or transfer funds as necessary to the FS for purposes of coordination and processing of geothermal leases and geothermal use authorizations on Federal land.

C. The details of the levels of support to be furnished to FS by the BLM, with respect to funding and personnel, will be developed in specific future agreements on an annual or case-by-case basis, contingent on the availability of identified staffing needs and types of funding.

XIV. COMMENCEMENT/EXPIRATION/TERMINATION AND MODIFICATION

As described in Section XIII. A. B. C., the Act mandates the establishment of a fund for geothermal leasing through fiscal year 2010. The MOU will continue beyond that date for the purposes of coordinating geothermal leasing. The BLM and FS will review this MOU every 5 years for currency and applicability. This MOU may be revised and modified as necessary; terms herein are contingent upon regulations yet to be promulgated. All parties potentially affected by a modification must sign the modification for it to be effective.

XV. MEETINGS

The agencies will meet on an annual basis. Additional coordination meetings or conference calls may be held as needed.

XVI. DISPUTE RESOLUTION

If a dispute arises under this MOU that is not resolved informally between or among the parties, then any party may pursue the following dispute resolution procedure:

A. The party that seeks resolution will provide a written statement of its dispute, along with any rationale or supporting documents, to the other interested party. The parties will engage in discussions in an attempt to arrive at a consensus and resolve the dispute.

B. If no resolution is reached within thirty (30) calendar days of receipt of the statement of dispute, then the dispute may be elevated to the parties' respective headquarters-level officials. If consensus is not achieved by the headquarters-level officials within thirty (30) calendar days of their receipt of the statement of dispute, the parties will promptly elevate the matter to the respective Secretaries' Offices, who will resolve the matter.

C. The time limits in the preceding paragraph may be extended on the agreement of the parties to the dispute.

XVII. SUPPLEMENTAL AGREEMENTS

Subsequent to the signing of this MOU, additional Federal or state interagency agreements may be required for the purposes of outlining more specific interagency relationships.

XVIII. NO PRIVATE RIGHT OF ACTION AND LIMITED APPLICABILITY

This MOU is not intended to, and does not create any right, benefit, or trust responsibility, substantive or procedural, enforceable at law or equity, by a person against the United States, its agencies, its officers, or any person. This MOU does not direct or apply to any person outside of the signatory Parties.

ACCORDINGLY, the parties have signed this MOU on the dates set forth below, to be effective for all purposes as of the date last signed. The signatures may be executed using counterpart original documents.

Kathleen Clarke 4/5/06

DIRECTOR, BUREAU OF LAND MANAGEMENT DATE

Dale N. Bosworth 4/10/06

CHIEF, FOREST SERVICE DATE

Geothermal Leasing on NFS Lands

The BLM and the Forest Service will coordinate geothermal resource leasing activities on NFS lands as follows:

J = joint responsibility S = sole responsibility

Action	Responsible Agency		Remarks
	BLM	FS	
Pre-Lease Environmental Documentation			
Serve as lead agency for geothermal leasing availability analyses and decisions and conduct analysis.		S	
Participate as co-lead agency or cooperating agency for geothermal leasing availability analyses and decisions for NFS lands.	S		
Analyze split estate lands (private surface/Federal minerals) within boundaries of NFS units.	J	J	Analysis and decision-making on all lands under Federal authority (both the BLM and the FS) within a defined leasing area will ensure consistency in geothermal resource management.
Provide expertise in the areas of geothermal engineering and geothermal geology on interdisciplinary teams performing environmental analyses for leasing on NFS lands.	S		The BLM must provide expertise in delegated program areas in geothermal operations, including ground water protection.
Provide Reasonably Foreseeable Development Scenario (RFD) for geothermal leasing on NFS lands.	S		Analysis must include information on geothermal reservoirs, resource distribution, and production characteristics, and must address downhole operations. The RFD will follow the Interagency Reference Guide "Reasonably Foreseeable Development Scenarios and Cumulative Effects Analysis". FS may need to provide information on surface use (roads, etc.) for inclusion or consideration in the RFD. RFD may be developed by other parties. If so, the BLM should provide final review.
Ensure consistency in lease stipulations across jurisdictional boundaries.	J	J	
Develop lease stipulations for NFS lands that are only as restrictive as necessary to protect the resources for which they are applied.		S	The FS should develop stipulations with the BLM input for consistency. (See above.)
Issue leasing decision.		S	The FS and the BLM should coordinate the signing and release of decision documents on leasing of NFS lands. NOTE: The BLM has sole decision authority for split estate lands (Federal minerals/private or State surface) within boundaries of Forest Service administrative units.)
Adopt FS leasing analysis.	S		

Action	Responsible Agency		Remarks
	BLM	FS	
Competitive Leasing			
Coordinate and schedule the BLM/FS meeting to develop a proposed competitive leasing schedule.	J	J	
Send written request to the FS for appropriate stipulation and special terms for lease issuance at least 180 days prior to sale.	S		
Utilize information in mineral resource assessment in future planning documents and decisions.	S		
Provide appropriate stipulations for NFS land involved in proposed lease sale and special terms for lease issuance at least 90 days prior to scheduled sale date.		S	.
Noncompetitive Leasing			
Transmit any noncompetitive lease application package involving NFS land to the FS within 30 days of receipt.	S		
Forward land parcel lease requests from the FS to appropriate Forest Supervisor for environmental clearance within 15 days of receipt.		S	
Complete a review of the existing NEPA document and transmit letter of consent or no consent to the BLM within 60 days from receipt of land parcel lease requests.		S	Coordinate with the BLM during the environmental review process, as outlined in Part VII. A.
Upon receipt of the FS consent and stipulation, make an independent decision as to whether to issue each lease within 30 days of conveying terms and conditions to applicant.	S		

J = joint responsibility S = sole responsibility

Action	Responsible Agency		Remarks
	BLM	**FS**	
Joint Data Retrieval System for the BLM and the FS to Track Status of Lease and Permit Applications			
Determine infrastructure, protocols, and procedures necessary to provide secure access to joint data retrieval systems and joint geographic information system. Provide security requirements to Forest Service.	S		The BLM program and IT staff will work with corresponding staff in Forest Service to determine standards.
Establish infrastructure, protocols, and procedures to meet the security requirements as determined by BLM for access to joint data retrieval systems and geographic information systems by designated Forest Service staff.		S	Implement security requirements to meet BLM standards for those Forest Service staff requiring access to the joint data retrieval systems.
Provide designated FS staff with the appropriate level of access to the joint data retrieval system.	S		At the initiation of this MOU the joint data retrieval systems include AFMSS, LR 2000, and NILS. The details and specifics of how the FS will access and use BLM systems will be documented in a Service Level Agreement consistent with BLM/DOI policies.
Provide the BLM with a completed BLM Form- 1260 for all FS users who need to access the joint data retrieval system.		S	.
Assure adequate system performance and security to maintain data integrity for FS users who access the joint data retrieval system.	S		
Utilize the BLM's Project Change Management Boards for requesting changes to the joint data retrieval system.		S	
Be responsible for the Information Technology management, including Project Change Management, of the joint data retrieval system.	S		

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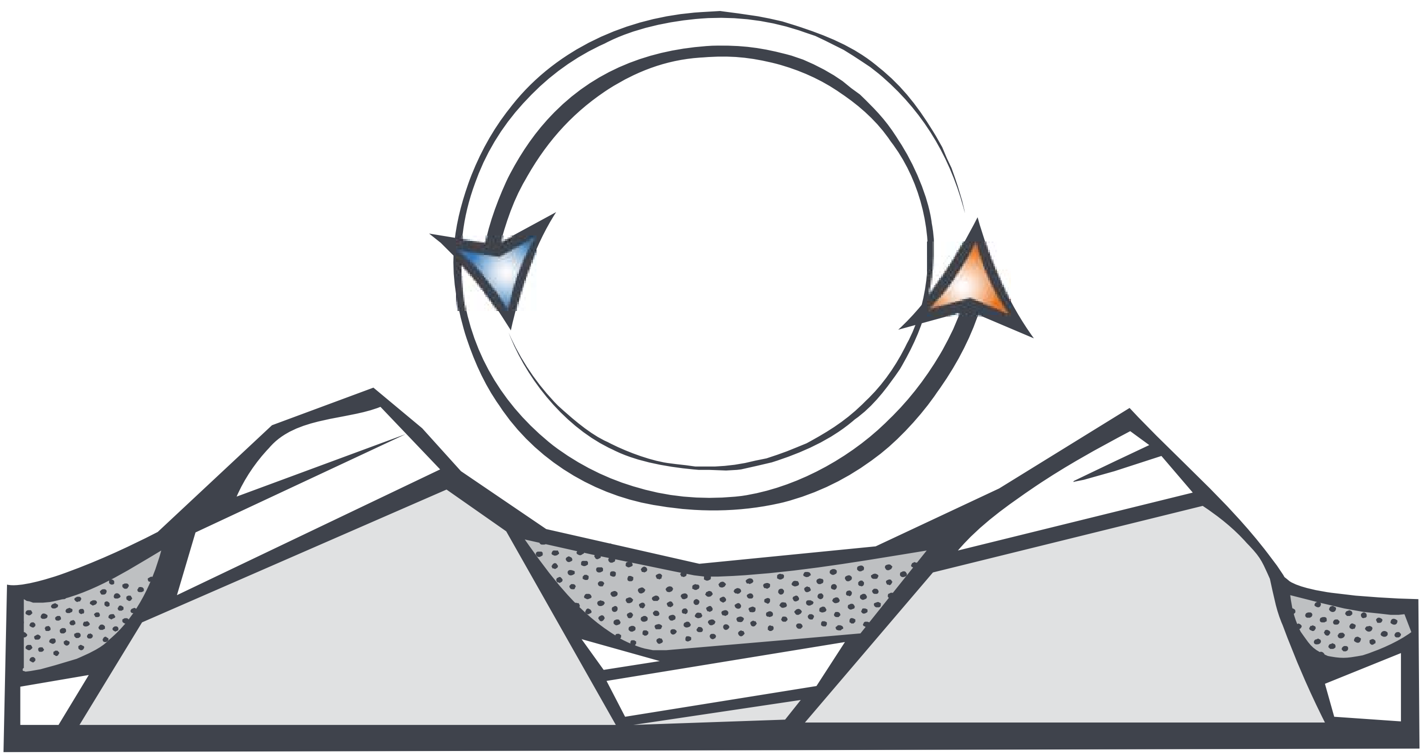

APPENDIX C

PRELIMINARY LIST OF ACEC STATUS FOR FLUID MINERAL LEASING

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Appendix C

Preliminary List of ACEC Status for Fluid Mineral Leasing

28-Mar-08

List of Acronyms : NSO = No Surface Occupancy, TL = Timing Limitations, CSU = Controled Ssurface Use, CSM = Control Surface Management, CNL =Closed to New Leasing, NNR = No New ROW

State	District and/or Field Office	ACEC Name	Acres	Closed to Leasing	Open to Geothermal Leasing	Applicable Stipulations*
AK	Central Yukon	Dulbi-Kaiyuh Mountains	7,039		OPEN	
AK	Central Yukon	Dulbi-Kaiyuh Mountains	6,435		OPEN	
AK	Central Yukon	Dulbi-Kaiyuh Mountains	10,036		OPEN	
AK	Central Yukon	Dulbi-Kaiyuh Mountains	4,439		OPEN	
AK	Steese NCA	Big Windy Hot Spring	152	CLOSED		
AK	Utility Corridor	Kanuti Hot Springs ACEC	43	CLOSED		
AK	Central Yukon	Ishtalitna Creek Hot Springs RNA	1,025	CLOSED		
AK	Central Yukon	McQuesten Creek RNA	3,930	CLOSED		
AK	Central Yukon	Spooky Valley RNA	10,072	CLOSED		
AK	Central Yukon	Tozitna Subunit South	62,645		OPEN	
AK	Central Yukon	Hogatza	30,509		OPEN	
AK	Central Yukon	Indian River Watershed	161,198		OPEN	
AK	Central Yukon	Tozitna River Watershed	947,111		OPEN	
AK	Central Yukon	Galena Mountain Watershed ACEC - East Unit	6,054		OPEN	
AK	Central Yukon	Tozitna Subunit North	128,799		OPEN	
NM	Roswell	North Pecos			OPEN	None
NM	Roswell	Overflow Wetlands			OPEN	None
NM	Roswell	Ft. Stanton		CLOSED		None
NM	Roswell	Mescalero Sands		CLOSED		None
NM	Roswell	Roswell Cave Complex		CLOSED		None
NM	Rio Puerco	Torrejon Fossil Fauna			OPEN	CSU
NM	Rio Puerco	Jones Canyon			OPEN	NSO
NM	Rio Puerco	San Luis Mesa Raptor Area			OPEN	TL, CSU
NM	Rio Puerco	Cabezon Peak		CLOSED		None
NM	Rio Puerco	Canon Tapia			OPEN	NSO
NM	Rio Puerco	Elk Springs			OPEN	TL, CSU
NM	Rio Puerco	Tent Rocks			OPEN	TL, CSU
NM	Rio Puerco	Ojito			OPEN	CSU
NM	Rio Puerco	Ball Ranch		CLOSED		None
NM	Rio Puerco	Pronoun Cave Complex			OPEN	CSU
NM	Rio Puerco	Bluewater Canyon			OPEN	NSO
NM	Farmington	Cedar Hill			OPEN	CSM
NM	Farmington	*Chacra Mesa Complex			OPEN	CSM, NSO
NM	Farmington	East Side Rincon			OPEN	CSM, NSO
NM	Farmington	Farmer's Arroyo			OPEN	NSO
NM	Farmington	La Jara			OPEN	CSM
NM	Farmington	*Andrews Ranch			OPEN	NSO, CNL

Appendix C

Preliminary List of ACEC Status for Fluid Mineral Leasing

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State	District and/or Field Office	ACEC Name	Acres	Closed to Leasing	Open to Geothermal Leasing	Applicable Stipulations*
NM	Farmington	*Bee Burrow			OPEN	NSO, CNL
NM	Farmington	*Bis Sa'ani			OPEN	NSO, CNL
NM	Farmington	Casa Del Rio		CLOSED		None
NM	Farmington	*Casamero Community			OPEN	NSO, CNL, NNR
NM	Farmington	Church Rock Outlier			OPEN	NSO, CNL
NM	Farmington	*Greenlee Ruin			OPEN	None
NM	Farmington	*Halfway House			OPEN	NSO, CNL, NNR
NM	Farmington	*Holmer Group			OPEN	NSO, CNL, NNR
NM	Farmington	*Indian Creek			OPEN	CNL, NNR
NM	Farmington	Jacques Chacoan Community			OPEN	NSO, NNR
NM	Farmington	*Kin Nizhoni			OPEN	NSO
NM	Farmington	Lake Valley			OPEN	NSO, CNL
NM	Farmington	*Morris 41			OPEN	NSO, CNL, NNR
NM	Farmington	*Pierre's Site			OPEN	NSO, CNL,NNR
NM	Farmington	*Toh-La-Kai			OPEN	NNR
NM	Farmington	*Twin Angels			OPEN	NSO, NNR
NM	Farmington	*Upper Kin Klizhin			OPEN	CNL, NNR
NM	Farmington	Ah-Shi-Sle-Pah Road			OPEN	CSM, NSO
NM	Farmington	*Crowpoint Steps and Herradura			OPEN	CSM, NNR
NM	Farmington	*North Road			OPEN	NSO, CNL
NM	Farmington	Adams Canyon			OPEN	NSO, NNR
NM	Farmington	Blanco Mesa			OPEN	NSO, NNR
NM	Farmington	Cagle's Site			OPEN	NSO
NM	Farmington	Canyon View Ruin			OPEN	NSO,NNR
NM	Farmington	Christmas Tree Ruin			OPEN	NSO, NNR
NM	Farmington	Cottonwood Divide			OPEN	NSO, NNR
NM	Farmington	Crow Canyon			OPEN	NSO, NNR
NM	Farmington	Deer House			OPEN	NSO, CSM, NNR
NM	Farmington	Devil's Spring Mesa			OPEN	NSO, CSM, NNR
NM	Farmington	Encinada Mesa-Carrizo Canyon			OPEN	NSO, NNR, CSM

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NM	Farmington	Frances Mesa			OPEN	NSO, CSM
NM	Farmington	Gould Pass Camp			OPEN	NSO
NM	Farmington	Humming Bird			OPEN	NSO, NNR
NM	Farmington	Kachina Mask			OPEN	NSO
NM	Farmington	Kin Yazhi			OPEN	NSO, NNR
NM	Farmington	Kiva			OPEN	NSO
NM	Farmington	Munoz Canyon			OPEN	CSM
NM	Farmington	Pointed Butte			OPEN	NSO, NNR
NM	Farmington	Pork Chop Pass			OPEN	NSO
NM	Farmington	Pretty Woman			OPEN	NSO, NNR
NM	Farmington	Prieta Mesa			OPEN	NSO, NNR
NM	Farmington	Rincon Largo District			OPEN	NSO, NNR
NM	Farmington	Rincon Rockshelter			OPEN	NSO
NM	Farmington	San Rafael Canyon			OPEN	CSM
NM	Farmington	Simon Ruin			OPEN	NSO, NNR
NM	Farmington	Star Rock			OPEN	NSO, NNR
NM	Farmington	String House			OPEN	NSO, NNR
NM	Farmington	Superior Mesa			OPEN	NSO, NNR
NM	Farmington	Tapacito and Split Rock			OPEN	NSO, NNR
NM	Farmington	Truby's Tower			OPEN	NSO
NM	Farmington	Albert Mesa			OPEN	NSO, NNR
NM	Farmington	Dogie Canyon School			OPEN	NSO
NM	Farmington	Gonzales Canyon-Senon S. Vigil Homestead			OPEN	NSO, NNR
NM	Farmington	Haynes Trading Post			OPEN	NSO
NM	Farmington	Margarita Martinez Homestead			OPEN	NSO, NNR
NM	Farmington	Martin Apodaca Homestead			OPEN	NSO
NM	Farmington	Moss Trail			OPEN	NSO, NNR
NM	Farmington	Rock House-Nestor Martin Homestead			OPEN	NSO
NM	Farmington	Santos Peak			OPEN	NSO
NM	Farmington	Ashiih Naa'a			OPEN	NSO, NNR
NM	Farmington	Cho'li'l			OPEN	NSO
NM	Farmington	Dzil'na'oodlii			OPEN	NSO, NNR
NM	Farmington	Bi Yaazh			OPEN	NSO
NM	Farmington	Blanco Star Panel			OPEN	NSO, NNR
NM	Farmington	Delgadita/Pueblo Canyons			OPEN	NSO, NNR
NM	Farmington	Encierro Canyon			OPEN	NSO

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State	District and/or Field Office	ACEC Name	Acres	Closed to Leasing	Open to Geothermal Leasing	Applicable Stipulations*
NM	Farmington	Four Ye'i			OPEN	NSO
NM	Farmington	Hummingbird Canyon			OPEN	NSO, NNR
NM	Farmington	Largo Canyon Star Ceiling			OPEN	NSO
NM	Farmington	Martinez Canyon			OPEN	NSO
NM	Farmington	Pregnant Basketmaker			OPEN	NSO
NM	Farmington	Shield Bearer			OPEN	NSO
NM	Farmington	Star Spring-Jesus Canyon			OPEN	NSO
NM	Farmington	Angel Peak			OPEN	NSO
NM	Farmington	*Simon Canyon			OPEN	NSO, CNL
NM	Farmington	Bald Eagle			OPEN	CSM
NM	Farmington	*The Hogback			OPEN	CSM, CNL
NM	Farmington	Mexican Spotted Owl			OPEN	CSM, NSO
NM	Farmington	River Tracts			OPEN	NSO
NM	Farmington	Ah-shi-sle-pah			OPEN	CNL
NM	Carslbad	Pecos River Canyons Complex			OPEN	NSO, NNR
NM	Carslbad	Lonesome Ridge			OPEN	NSO, NNR
NM	Carslbad	Dark Canyon			OPEN	NSO, NNR
NM	Carslbad	Chosa Draw			OPEN	NSO, NNR
NM	Carslbad	Blue Spring			OPEN	NSO, NNR
NM	Las Cruces	Three Rivers			OPEN	
NM	Las Cruces	Sacramento Escarpment			OPEN	
NM	Las Cruces	Cornudas Mts.			OPEN	
NM	Las Cruces	Alamo			OPEN	
NM	Las Cruces	Wind Mt.			OPEN	
NM	Las Cruces	Alkali Lakes			OPEN	
NM	Las Cruces	Alamo Hueco Mtns.			OPEN	
NM	Las Cruces	Apache Box			OPEN	
NM	Las Cruces	Big Hatchet Mtns			OPEN	
NM	Las Cruces	Bear Creek			OPEN	
NM	Las Cruces	Central Peloncillo Mtns.			OPEN	
NM	Las Cruces	Cooke's Range			OPEN	
NM	Las Cruces	Cowboy Spring			OPEN	
NM	Las Cruces	Florida Mtns			OPEN	
NM	Las Cruces	Gila Lower Box			OPEN	
NM	Las Cruces				OPEN	
NM	Las Cruces	Gila Middle Box			OPEN	
NM	Las Cruces	Granite Gap			OPEN	
NM	Las Cruces	Guadalupe Canyon			OPEN	
NM	Las Cruces	Los Tules		CLOSED		NSO

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State	District and/or Field Office	ACEC Name	Acres	Closed to Leasing	Open to Geothermal Leasing	Applicable Stipulations*
NM	Las Cruces	Northern Peloncillo Mtns.			OPEN	
NM	Las Cruces	Old Town			OPEN	
NM	Las Cruces	Organ/Franklin Mtns		CLOSED		
NM	Las Cruces	Rincon		CLOSED		NSO
NM	Las Cruces	Robledo Mtns			OPEN	
NM	Las Cruces	San Diego Mtn.			OPEN	
NM	Las Cruces	Uvas Valley			OPEN	
NM	Las Cruces	Aden Lava Flow RNA			OPEN	
NM	Las Cruces	Antelope Pass RNA			OPEN	
NM	Las Cruces	Kilbourne Hole NNL			OPEN	
NM	Las Cruces	Lordsburg Playa RNA			OPEN	
NM	Las Cruces	Paleozoic Trackways RNA			OPEN	
NM	Socorro	Ladron Mt/Devil's Backbone Complex			OPEN	NSO
NM	Socorro	Cerro Pomo			OPEN	
NM	Socorro	Horse Mountain			OPEN	NSO
NM	Socorro	Tinajas	40	CLOSED		
NM	Socorro	Sawtooth			OPEN	NSO
NM	Socorro	San Pedro			OPEN	NSO
NM	Socorro	Zuni Salt Lake	46,746	CLOSED		
NM	Socorro	Pelona Mountain			OPEN	CSU
NM	Taos	San Antonio Gorge	547		OPEN	NSO
NM	Taos	San Antonio WSA	7,000	CLOSED		None
NM	Taos	San Antonio	75,500		OPEN	CSU
NM	Taos	Winter Range	6,688		OPEN	TL
NM	Taos	Rio Grande and Red Wild and Scenic	17,286	CLOSED		None
NM	Taos	Wild Rivers Recreation Area			OPEN	NSO
NM	Taos	Orilla Verde Recreation Area	8,406	CLOSED		None
NM	Taos	Copper Hill			OPEN	NSO
NM	Taos	Lower Gorge	16,351	CLOSED		None
NM	Taos	Black Mesa			OPEN	CSU
NM	Taos	Ojo Caliente	13,000		OPEN	CSU
NM	Taos	Sombrillo	9,000		OPEN	CSU
NM	Taos	Ku Pueblo	65		OPEN	NSO
NM	Taos	Ojo de Zorro Pueblo	24		OPEN	NSO
NM	Taos	Pueblo Quemado	159		OPEN	NSO
NM	Taos	Pueblo Sarco	10		OPEN	NSO

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State	District and/or Field Office	ACEC Name	Acres	Closed to Leasing	Open to Geothermal Leasing	Applicable Stipulations*
NM	Taos	San Lazaro Pueblo	77		OPEN	NSO
NM	Taos	La Cienega	3,556		OPEN	NSO
NM	Taos	Rio Chama	19,956	CLOSED		None
NM	Taos	Santa Cruz Lake Recreation Area	640		OPEN	NSO
NM	Taos	Sabinoso WSA	15,760	CLOSED		None
NM	Taos	Riparian Aquatic			OPEN	None
NV	Elko	Salt Lake	6037			
NV	Winnemucca	Osgood Mountains Milkvetch	60		OPEN	NSO
NV	Winnemucca	Soldier Meadows	2,770	CLOSED		
NV	Winnemucca	High Rock Canyon	5,664	CLOSED		
NV	Carson City	Carson Wandering Skipper	243	CLOSED		
NV	Carson City	Incandescent Rocks	1072		OPEN	
NV	Carson City	Pah Rah High Basin Petroglyph District	3881	CLOSED		
NV	Carson City	Steamboat	40	CLOSED		
NV	Carson City	Stewart Valley	16000		OPEN	None
NV	Carson City	Virginia Range Williams Combleaf Habitat	473	CLOSED		
NV	Ely	Beaver Dam Slope	36900			
NV	Ely	Kane Springs	65900			
NV	Ely	Morman Mesa	109700		OPEN	NSO
NV	Las Vegas	Arden Historic Sites	1480		OPEN	NSO
NV	Las Vegas	Armagosa Mesquite	6891		OPEN	TL, CSU
NV	Las Vegas	Arrow Canyon	2084		OPEN	NSO
NV	Las Vegas	Ash Meadows	37152	CLOSED		
NV	Las Vegas	Big Dune	1920		OPEN	NSO
NV	Las Vegas	Bird Spring	161		OPEN	NSO
NV	Las Vegas	Coyote Springs	75500		OPEN	NSO
NV	Las Vegas	Crescent Townsite	437		OPEN	NSO
NV	Las Vegas	Devil's Throat	640		OPEN	NSO, NNR
NV	Las Vegas	Gold Butte Part A	185569		OPEN	NSO
NV	Las Vegas	Gold Butte Part B	118937		OPEN	TL, CSU
NV	Las Vegas	Gold Butte Part C (Virgin Mtns)	38431	CLOSED		
NV	Las Vegas	Gold Butte Townsites	160		OPEN	NSO, NNR
NV	Las Vegas	Hidden Valley	3360		OPEN	NSO
NV	Las Vegas	Keyhole Canyon	361		OPEN	NSO

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State	District and/or Field Office	ACEC Name	Acres	Closed to Leasing	Open to Geothermal Leasing	Applicable Stipulations*
NV	Las Vegas	Morman Mesa	151360		OPEN	NSO
NV	Las Vegas	Piute/Eldorado	329440		OPEN	NSO
NV	Las Vegas	Rainbow Gardens	37620		OPEN	NSO
NV	Las Vegas	Red Rock Springs	640		OPEN	NSO, NNR
NV	Las Vegas	River Mountains	5617		OPEN	NSO
NV	Las Vegas	Sloan Rock Art District	0		OPEN	NSO
NV	Las Vegas	Stump Spring	641		OPEN	NSO
NV	Las Vegas	Timber Mountain Caldera	110720			
NV	Las Vegas	Virgin River	6411		OPEN	NSO
NV	Las Vegas	Whitney Pocket	160		OPEN	NSO, NNR
NV	Battle Mt	Lunar Crater	39,680		OPEN	
NV	Battle Mt	Amargosa-Oasis	490		OPEN	
NV	Battle Mt	Cane Man Hill	680		OPEN	
NV	Battle Mt	Lone Mountain	14,400		OPEN	
NV	Battle Mt	Railroad Valley	15,470		OPEN	
NV	Battle Mt	Rhyolite	425		OPEN	
NV	Battle Mt	Tybo-McIntyre Charcoal Kilns	80		OPEN	
ID	Four Rivers	Snake River Birds of Prey NCA	26,300	CLOSED		
ID	Four Rivers	Guffey Butte/Black Butte Archaeological District			OPEN	
ID	Four Rivers	Boise Front	12000		OPEN	None
ID	Four Rivers	Columbian Sharp-tailed Gouse Habitat	4200		OPEN	TL
ID	Four Rivers	Long-billed Curlew Habitat	61000		OPEN	TL
ID	Owyhee	Owyhee River Bighorn Sheep Habitat Area	112276		OPEN	NSO
ID	Owyhee	Boulder Creek ONA	6978		OPEN	NSO
ID	Owyhee	Coal Mine Basin RNA	1604		OPEN	NSO
ID	Owyhee	Guffey Butte/Black Butte Archaeological District	7,750	CLOSED		
ID	Owyhee	McBride Creek RNA	261	CLOSED		
ID	Owyhee	Jump Creek Canyon	612	CLOSED		
ID	Owyhee	Cinnabar	277	CLOSED		
ID	Owyhee	Pleasant Valley Table RNA	1467	CLOSED		
ID	Owyhee	Sommercamp Butte RNA	440	CLOSED		
ID	Owyhee	Squaw Creek RNA	150	CLOSED		
ID	Owyhee	The Badlands RNA	1833	CLOSED		
ID	Owyhee	The Tules RNA	114	CLOSED		

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State	District and/or Field Office	ACEC Name	Acres	Closed to Leasing	Open to Geothermal Leasing	Applicable Stipulations*
ID	Owyhee	North Fork Juniper Woodland ONA	4204	CLOSED		
ID	Bruneau	Mud Flat Oolite RNA	5		OPEN	NSO
ID	Bruneau	Owyhee River Bighorn Sheep Habitat Area	56123		OPEN	NSO
ID	Bruneau	Triplet Butte	304		OPEN	NSO
ID	Bruneau	Cottonwood Creek	325		OPEN	NSO
ID	Jarbidge	Sand Point	810		OPEN	NSO
ID	Jarbidge	Salmon Falls Creek	2697		OPEN	NSO
ID	Jarbidge	Bruneau-Jarbidge River	85224		OPEN	NSO
ID	Salmon	Trial Creek			OPEN	NSO
ID	Salmon	Sevenmile			OPEN	NSO
ID	Upper Snake	North Menan Butte	1120		OPEN	NSO
ID	Upper Snake	Nine Mile Knoll	40090		OPEN	NSO
ID	Upper Snake	Snake River	11120		OPEN	NSO
ID	Upper Snake	Henry's Lake	1681		OPEN	NSO
ID	Upper Snake	North Menan Butte RNA			OPEN	NSO
ID	Upper Snake	St. Anthony Sand Dunes RNA			OPEN	NSO
ID	Upper Snake	Game Creek RNA			OPEN	NSO
ID	Upper Snake	Reid Canal Island RNA			OPEN	NSO
ID	Upper Snake	Pine Creek RNA			OPEN	NSO
ID	Upper Snake	Squaw Creek RNA			OPEN	NSO
ID	Upper Snake	China Cup Butte		CLOSED		
ID	Challis	Antelope Flat RNA			OPEN	
ID	Challis	Birch Creek			OPEN	
ID	Challis	Cronk's Canyon RNA			OPEN	
ID	Challis	Donkey Hills			OPEN	
ID	Challis	Dry Gulch RNA			OPEN	
ID	Challis	East Fork Salmon River Bench RNA			OPEN	
ID	Challis	Herd Creek Watershead RNA			OPEN	
ID	Challis	Lone Bird			OPEN	
ID	Challis	Malm Gulch/Germer Basin RNA			OPEN	
ID	Challis	Peck's Canyon RNA			OPEN	
ID	Challis	Penal Gulch			OPEN	
ID	Challis	Sand Hollow			OPEN	

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State	District and/or Field Office	ACEC Name	Acres	Closed to Leasing	Open to Geothermal Leasing	Applicable Stipulations*
ID	Challis	Summit Creek RNA			OPEN	
ID	Challis	Thousand Springs RNA			OPEN	
ID	Pocatello	Downey Watershead			OPEN	NSO
ID	Pocatello	Bown Canyon Blad Eagle Sanctury			OPEN	NSO
ID	Pocatello	Old Juniper Townsite			OPEN	NSO
ID	Pocatello	Indian Rocks			OPEN	NSO
ID	Pocatello	Travertine Park			OPEN	NSO
ID	Pocatello	Stump Creek			OPEN	NSO
ID	Pocatello	Van Komn Homestead			OPEN	NSO
ID	Pocatello	Dairy Hollow RNA			OPEN	NSO
ID	Pocatello	Formation Cave RNA			OPEN	NSO
ID	Pocatello	Oneida Narrows RNA			OPEN	NSO
ID	Pocatello	Pine Gap RNA			OPEN	NSO
ID	Pocatello	Robber's Roost RNA			OPEN	NSO
ID	Pocatello	Cheatbeck Canyon RNA			OPEN	NSO
ID	Burley	Granite Pass-Goose Creek Trail			OPEN	TL
ID	Burley	Goose Creek Mesa		CLOSED		
ID	Burley	Jim Sage Canyon			OPEN	TL
ID	Burley	Oregon California Trail Junction			OPEN	
ID	Burley	Salmon Falls Creek			OPEN	NSO
ID	Burley/Shoshone	Sub-Station Tract			OPEN	NSO
ID	Burley/Shoshone	Playas			OPEN	NSO
ID	Burley/Shoshone	Box Canyon			OPEN	
ID	Burley/Shoshone	Vineland Lake			OPEN	
ID	Shoshone	King Hill			OPEN	
ID	Shoshone	McKinney Butte			OPEN	
ID	Shoshone	Tee-Maze			OPEN	
ID	Shoshone	Big Beaver			OPEN	
ID	Shoshone	Sun Peak			OPEN	
ID	Shoshone	Elk Mountain			OPEN	
OR	Lakeview	Devils Garden ACEC	28,241	CLOSED		
OR	Lakeview	Lake Abert ACEC	50,165	CLOSED		NSO
OR	Lakeview	Lost Forest/Sand Dunes/Fossil Lake ACEC Complex	8,500	OPEN		None
OR	Lakeview	Lost Forest RNA	8,883	CLOSED		
OR	Lakeview	Sand Dunes	9,125	CLOSED		

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State	District and/or Field Office	ACEC Name	Acres	Closed to Leasing	Open to Geothermal Leasing	Applicable Stipulations*
OR	Lakeview	Fossil Lake	8,988		OPEN	NSO
OR	Lakeview	Warner Wetlands ACEC	52,033		OPEN	NSO
OR	Lakeview	Abert Rim ACEC	18,049	CLOSED		
OR	Lakeview	Black Hills ACEC/RNA	3,048		OPEN	NSO
OR	Lakeview	Connley Hills ACEC/RNA	3,599		OPEN	NSO
OR	Lakeview	Fish Creek Rim ACEC/RNA	8,725		OPEN, portion closed	
OR	Lakeview	Foley Lake ACEC/RNA	2,230		OPEN	
OR	Lakeview	Guano Creek/Sink Lakes ACEC/RNA	11,199	CLOSED		
OR	Lakeview	Hawksie-Walksie ACEC/RNA	17,339	CLOSED		
OR	Lakeview	High Lakes ACEC	38,985		OPEN	
OR	Lakeview	Juniper Mountain ACEC/RNA	6,335		OPEN	NSO
OR	Lakeview	Rahilly-Gravelly ACEC/RNA	19,648		OPEN	NSO
OR	Lakeview	Red Knoll ACEC	11,127		OPEN	
OR	Lakeview	Spanish Lake ACEC/RNA	4,699		OPEN	
OR	Lakeview	Table Rock ACEC	5,139		OPEN	NSO
OR	Klamath Falls	Upper Klamath River ACEC	5,092		OPEN	NSO
OR	Klamath Falls	Miller Creek ACEC	2,000		OPEN	NSO
OR	Klamath Falls	Yainax Butte ACEC	720		OPEN	NSO
OR	Klamath Falls	Spencer Creek OHV Vehicle Closure (Riparian)	320		OPEN	NSO
OR	Klamath Falls	Clover Creek Forest Educational Area	30		OPEN	NSO
OR	Klamath Falls	Surveyor Forest Special Management Area	150		OPEN	NSO
OR	Klamath Falls	Bumpheads Special Management Area	50		OPEN	NSO
OR	Klamath Falls	Old Baldy Research Natural Area	620		OPEN	NSO
OR	Klamath Falls	Alkali Lake Special Management Area	240		OPEN	NSO
OR	Klamath Falls	Tunnel Creek Special Management Area	280		OPEN	NSO
OR	Klamath Falls	Wood River Wetland	3,220		OPEN	NSO
OR	Klamath Falls	Four Mile Wetland	1,173		OPEN	NSO

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State	District and/or Field Office	ACEC Name	Acres	Closed to Leasing	Open to Geothermal Leasing	Applicable Stipulations*
WY	Casper	Jackson Canyon			OPEN	NSO
WY	Casper	Salt Creek			OPEN	None
WY	Casper	Alcova Fossil Area			OPEN	None
WY	Casper	Bates Hole			OPEN	CSU
WY	Cody	Carter Mountain	7819		OPEN	None
WY	Cody	Chapman Bench	160		OPEN	None
WY	Cody	Five Springs Falls	160		OPEN	NSO
WY	Cody	Little Mountain	22,270		OPEN	None
WY	Cody	Sheep Mtn Anticline	12,285		OPEN	NSO
WY	Kemmer	Raymond Mountain			OPEN	
WY	Lander	Green Mountain			OPEN	
WY	Newcastle	Whoopup Canyon			OPEN	
WY	Pinedale	Rock Creek			OPEN	
WY	Pinedale	Beaver Creek			OPEN	
WY	Rawlings	Como Bluff			OPEN	
WY	Rawlings	Sand Hills			OPEN	
WY	Rawlings	Jep Canyon			OPEN	
WY	Rawlings	Shamrock Hills			OPEN	
WY	Rock Springs	Greater Red Creek	131,890	CLOSED		
WY	Rock Springs	Greater Sand Dunes	38650		OPEN	TL
WY	Rock Springs	Natural Corrals	1276		OPEN	NSO
WY	Rock Springs	Oregon Buttes	3450	CLOSED		
WY	Rock Springs	Pine Springs	6030		OPEN	
WY	Rock Springs	Steamboat Mtn	43270		OPEN	
WY	Rock Springs	South Pass Historic Landsc	53780		OPEN	
WY	Rock Springs	White Mtn Petroglyphs	20		OPEN	TL, NSO
WY	Worland	Upper Owl Creek			OPEN	
WY	Worland	Spanish Point Karst		CLOSED		

* Stipulations and limitions are based on information provided. The lack of such constraints does not mean that they do not exist for the

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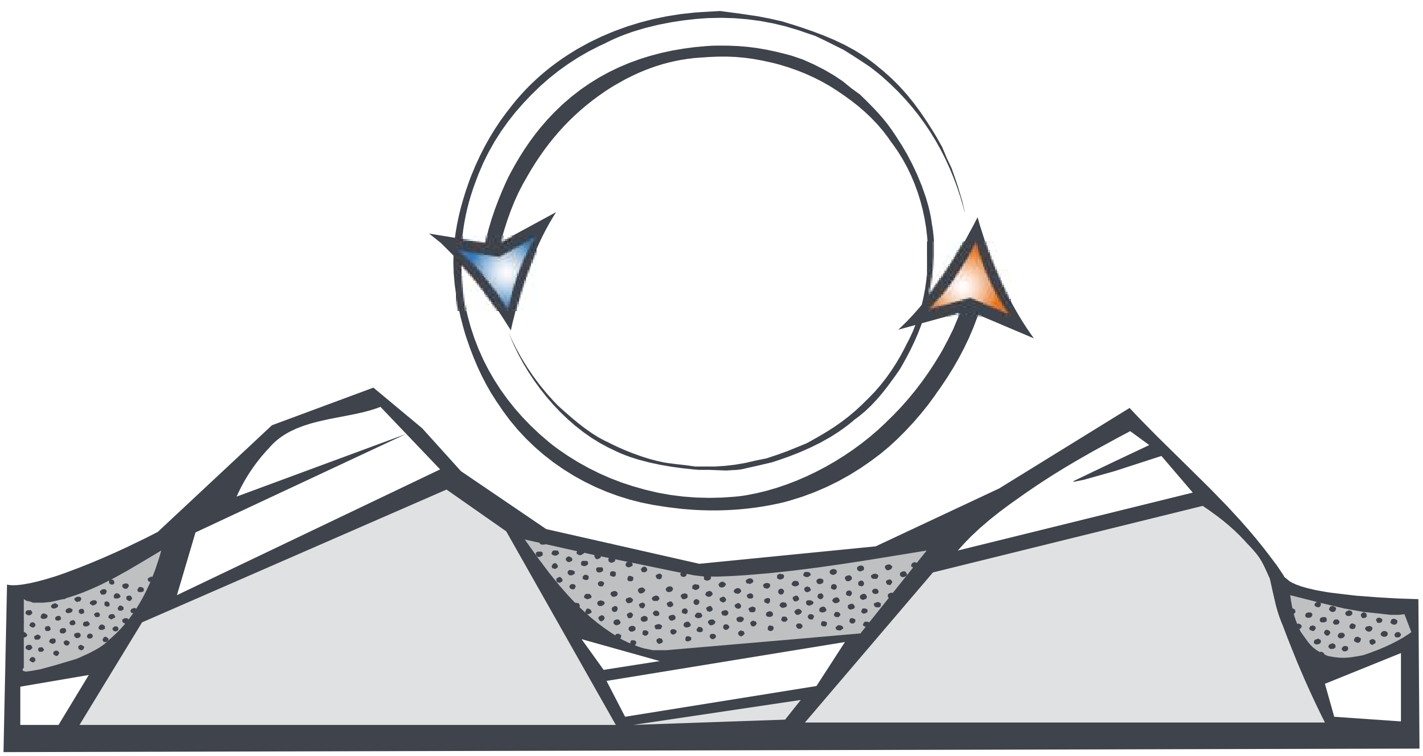

Appendix D

Best Management Practices and Mitigation Measures

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APPENDIX D
BEST MANAGEMENT PRACTICES AND MITIGATION MEASURES

Best Management Practices (BMP) are state-of-the-art mitigation measures applied on a site-specific basis to avoid, minimize, reduce, rectify, or compensate for adverse environmental or social impacts. They are applied to management actions to aid in achieving desired outcomes for safe, environmentally responsible resource development, by preventing, minimizing, or mitigating adverse impacts and reducing conflicts.

This appendix provides a list of sample Best Management Practices that have been collected from various BLM and FS documents addressing geothermal and fluid mineral leasing and development, including resource management plans (RMPs), forest plans, and environmental reports for geothermal leasing and development. The purpose of this appendix is to provide a list of recommended BMPs that would be incorporated as appropriate into the permit application by the lessee or would be included in the approved use authorization by the BLM as conditions of approval. When implementing new BMPs, offices are encouraged to work with an affected lessee early in the process, to explain how BMPs may fit into their development proposals and how BMPs can be implemented with the least economic impact to the lessee. Offices should discuss potential resource impacts with the lessee and seek the operator's recommended solutions. The office should also encourage the lessee to incorporate necessary and effective BMPs into their project proposal. Best Management Practices not incorporated into the permit application by the lessee may be considered and evaluated through the environmental review process and incorporated into the use authorization as conditions of approval or rights-of-way stipulations.

All offices will incorporate appropriate environmental BMPs into proposed use authorizations after appropriate environmental review. Environmental BMPs to be considered in nearly all circumstances include the following:

- Interim reclamation of well locations and access roads soon after the well is put into production;
- Painting of all new facilities a color that best allows the facility to blend with the background, typically a vegetated background;
- Design and construction of all new roads to a safe and appropriate standard, "no higher than necessary" to accommodate their intended use; and
- Final reclamation recontouring of all disturbed areas, including access roads, to the original contour or a contour that blends with the surrounding topography.

Other environmental BMPs are more suitable for consideration by an administrative unit on a case-by-case basis, (1) depending on their effectiveness, (2) the balancing of increased operating costs vs. the benefit to the public and resource values, (3) the availability of less restrictive mitigation alternatives that accomplish the same objective, and (4) other site specific factors. Examples of typical, case-by-case BMPs are identified below.

Guidelines for applying and selecting project-specific requirements include determining whether the measure would (1) ensure compliance with relevant statutory or administrative requirements, (2) minimize local impacts associated with siting and design decisions, (3) promote post construction stabilization of impacts, (4) maximize restoration of previous habitat conditions, (5) minimize cumulative impacts, or (6) promote economically feasible development of geothermal energy on BLM-administered or FS-administered land.

The following typical BMPs provide the BLM, FS, industry, and stakeholders a menu of improved practices for developing geothermal energy and minimize impacts to the biophysical and cultural landscape. The list is extensive but is not meant to be all inclusive given the constant development of improved practices, diversity of the western states, and potential for unique site-specific conditions. Local land use plans may contain other BMPs that better address such unique situations. Where the BMPs presented here are inconsistent with or incompatible with those developed under a specific land use plan, the staff will conduct an environmental review to determine the appropriate practices.

Only those individual mitigation measures reasonably necessary to ensure environmentally responsible geothermal development should be selected from the list below. Not all of the individual mitigation measures below will apply in most situations and selection of appropriated BMPs and mitigation measures should be dependent on factors such as the project size, location, site specific characteristics, and potential resource impacts. Prior to inclusion into a permit, the measures may be further modified to meet site-specific situations and agency requirements.

A menu of typical BMPs can also be found on the BLM Washington Office Fluid Minerals web site at: www.blm.gov/bmp

Note: Commenters to the Draft EIS noted that the list of BMPs and mitigation measures appeared to be redundant, contradictory, confusing, and placed extensive emphasis on certain resources while deemphasizing others. The following list has been consolidated and updated to address those concerns. The BMPs and mitigation measures are arranged from Information Collection and Monitoring to Final Reclamation and have been further subcategorized. While many of the BMPs and mitigation measures will apply to all phases of geophysical exploration and development; to avoid duplication, the measures are listed only once.

INFORMATION COLLECTION & MONITORING

General

- Prior to geothermal exploration and development, a complete subsurface geotechnical investigation will be conducted to analyze the soil and geologic conditions. The investigation will evaluate and identify potential geologic hazards and would provide remedial grading recommendations, foundation and slab design criteria, and soil parameters for the design of geothermal power infrastructure.
- The operator will collect available information describing the environmental and socio-cultural conditions in the vicinity of the proposed project and will provide the information to the agency.
- A monitoring program will be developed by the operator to ensure that environmental conditions are monitored during the exploration and well drilling, testing, construction, and utilization and reclamation phases. The monitoring program requirements, including adaptive management strategies, will be established at the project level to ensure that potential adverse impacts of geothermal development are mitigated. The monitoring program will identify the monitoring requirements for each major environmental resource present at the site, establish metrics against which monitoring observations can be measured, identify potential mitigation measures, and establish protocols for incorporating monitoring observations and additional mitigation measures into ongoing activities. The operator will provide results of the monitoring program to the agency in an annual report.
- [Refer to the Reclamation section for reclamation-specific monitoring.]

- The operator will comply with the Secretary of Agriculture's rules and regulations for all use and occupancy of the NFS lands prior to approval of an exploration plan by the Secretary of Interior and for uses of all existing improvements, such as forest development roads, within and outside the area permitted by the Secretary of Interior; and use and occupancy of the NFS lands not authorized by an exploration plan approved by the Secretary of Interior.

Paleontological and Cultural Resources

- Before any specific permits are issued under leases, treatment of cultural resources will follow the procedures established by the Advisory Council on Historic Preservation for compliance with Section 106 of the National Historic Preservation Act. A pedestrian inventory will be undertaken of all portions that have not been previously surveyed or are identified by BLM as requiring inventory to identify properties that are eligible for the NRHP. Those sites not already evaluated for NRHP eligibility will be evaluated based on surface remains, subsurface testing, archival, and/or ethnographic sources. Subsurface testing will be kept to a minimum whenever possible if sufficient information is available to evaluate the site or if avoidance is an expected mitigation outcome. Recommendations regarding the eligibility of sites will be submitted to the BLM, and a treatment plan will be prepared to detail methods for avoidance of impacts or mitigation of effects. The BLM will make determinations of eligibility and effect and consult with SHPO as necessary based on each proposed lease application and project plans. The BLM may require modification to exploration or development proposals to protect such properties, or disapprove any activity that is likely to result in adverse effects that cannot be successfully avoided, minimized or mitigated. Avoidance of impacts through project design will be given priority over data recovery as the preferred mitigation measure. Avoidance measures include moving project elements away from site locations or to areas of previous impacts, restricting travel to existing roads, and maintaining barriers and signs in areas of cultural sensitivity. Any data recovery will be preceded by approval of a detailed research design, Native American Consultation, and other requirements for BLM issuance of a permit under the Archaeological Resources Protection Act (BLM 2007a).
- If cultural resources are present at the site, or if areas with a high potential to contain cultural material have been identified, a cultural resources management plan (CRMP) will be developed. This plan will address mitigation activities to be taken for cultural resources found at the site. Avoidance of the area is always the preferred mitigation option. Other mitigation options include archaeological

survey and excavation (as warranted) and monitoring. If an area exhibits a high potential, but no artifacts were observed during an archaeological survey, monitoring by a qualified archaeologist could be required during all excavation and earthmoving in the high-potential area. A report will be prepared documenting these activities. The CRMP also will (1) establish a monitoring program, (2) identify measures to prevent potential looting/vandalism or erosion impacts, and (3) address the education of workers and the public to make them aware of the consequences of unauthorized collection of artifacts and destruction of property on public land (BLM 2005).

- Operators will determine whether paleontological resources exist in a project area on the basis of the sedimentary context of the area, a records search for past paleontological finds in the area, and/or, depending on the extent of existing information, a paleontological survey.
- If paleontological resources are present at the site, or if areas with a high potential to contain paleontological material have been identified, a paleontological resources management plan will be developed. This plan will include a mitigation plan for avoidance, removal of fossils, or monitoring. If an area exhibits a high potential but no fossils were observed during survey, monitoring by a qualified paleontologist may be required during excavation and earthmoving in the sensitive area. The operator will submit a report to the agency documenting these activities. The paleontological resources management plan also will (1) establish a monitoring program, (2) identify measures to prevent potential looting/vandalism or erosion impacts, and (3) address the education of workers and the public to make them aware of the consequences of unauthorized collection of fossils on public land.

Water Resources

- Operators will develop a storm water management plan for the site to ensure compliance with applicable regulations and prevent off-site migration of contaminated storm water or increased soil erosion.
- Operators will gain a clear understanding of the local hydrogeology. Areas of groundwater discharge and recharge and their potential relationships with surface water bodies will be identified.
- Operators will avoid creating hydrologic conduits between two aquifers during foundation excavation and other activities.

Vegetation and Fish and Wildlife

- The operator will conduct surveys for plant and animal species that are listed or proposed for listing as threatened or endangered and their habitats in areas proposed for development where these species could potentially occur, following accepted protocols and in consultation with the USFWS or NMFS, as appropriate. Particular care should be taken to avoid disturbing listed species during surveys in any designated critical habitat. The operator will monitor activities and their effects on ESA-listed species throughout the duration of the project.
- The operator will identify important, sensitive, or unique habitat and biota in the project vicinity and site and should design the project to avoid (if possible), minimize, or mitigate potential impacts on these resources. The design and siting of the facilities will follow appropriate guidance and requirements from the BLM, FS, and other resource agencies, as available and applicable.

National Scenic and Historic Trails

- When any ROW application includes remnants of a National Historic Trail, is located within the viewshed of a National Historic Trail's designated centerline, or includes or is within the viewshed of a trail eligible for listing on the NRHP, the operator will evaluate the potential visual impacts to the trail associated with the proposed project and identify appropriate mitigation measures for inclusion in the operation plan.

Air Quality and Climate

- The operator will coordinate with the [State Air Quality Division] to develop and implement an air quality monitoring plan.

PLANNING, LOCATION, AND DESIGN

Traffic Planning

- Operators will consult with local planning authorities regarding increased traffic prior to the construction phase, including an assessment of the number of vehicles per day, their size, and type. Specific issues of concern (e.g., location of school bus routes and stops) will be identified and addressed in the traffic management plan.

Roads & Pads

- To plan for efficient use of the land, necessary infrastructure will be consolidated wherever possible.
- Existing roads and pad sites will be used to the maximum extent feasible, but only if located in a safe and environmentally sound location. No new roads and pad sites will be constructed without

agency authorization. If new roads and pad sites have been authorized, they will be designed and constructed by the operator to the appropriate agency standard, no higher than necessary to accommodate their intended function. Roads and pad sites will be routinely maintained by the operator maintain public safety and to minimize impacts to the environment such as erosion, sedimentation, fugitive dust, loss of vegetation.

- An access road siting and management plan will be prepared incorporating existing Agency standards regarding road design, construction, and maintenance such as those described in the BLM 9113 Manual and the *Surface Operating Standards for Oil and Gas Exploration and Development* (i.e., the Gold Book, 4th Edition, 2007).
- A traffic management plan will be prepared for the site access roads to ensure that no hazards would result from the increased truck traffic and that traffic flow would not be adversely impacted. This plan will incorporate measures such as informational signs, flaggers when equipment may result in blocked throughways, and traffic cones to identify any necessary changes in temporary lane configuration.
- Where possible, access roads will be located to follow natural contours and minimize side hill cuts and fills. Excessive grades on roads, road embankments, ditches, and drainages shall be avoided, especially in areas with erodible soils.
- Roads will be designed so that changes to surface water runoff are minimized and new erosion is not initiated.
- Access roads will be located to minimize stream crossings. All structures crossing streams will be located and constructed so that they do not decrease channel stability or increase water velocity. Operators will obtain all applicable federal and state water crossing permits.
- Roads will be located away from drainage bottoms and avoid wetlands, if practicable.

Geotechnical Analysis

- The operator will perform a detailed geotechnical analysis prior to the construction of any structures; so they will be sited to avoid any hazards from subsidence or liquefaction (i.e., the changing of a saturated soil from a relatively stable solid state to a liquid during earthquakes or nearby blasting).

Visual Mitigation

- The operator will incorporate visual design considerations into the planning and design of the project to minimize potential visual impacts of the proposal and to meet the VRM objectives of the area and the agency.

Visual Design Considerations

- Construct low-profile structures whenever possible to reduce structure visibility.
- Select and design materials and surface treatments to repeat or blend with landscape elements.
- Site projects outside of the viewsheds of publically accessible vantage points, or if this cannot be avoided, as far away as possible;
- Site projects to take advantage of both topography and vegetation as screening devices to restrict views of projects from visually sensitive areas;
- Site facilities away from and not adjacent to prominent landscape features (e.g., knobs and water features);
- Avoid placing facilities on ridgelines, summits, or other locations such that they will be silhouetted against the sky from important viewing locations;
- Collocate facilities to the extent possible to use existing and shared rights-of-way, existing and shared access and maintenance roads, and other infrastructure to reduce visual they do not bisect ridge tops or run down the center of valley bottoms.
- Site linear features (aboveground pipelines, rights-of-way, and roads) to follow natural land contours rather than straight lines (particularly up slopes) when possible. Fall-line cuts should be avoided.
- Site facilities, especially linear facilities, to take advantage of natural topographic breaks (i.e., pronounced changes in slope) to avoid siting facilities on steep side slopes.
- Where available, site linear features such as rights-of-ways and roads to follow the edges of clearings (where they will be less conspicuous) rather than passing through the centers of clearings.
- Site facilities to take advantage of existing clearings to reduce vegetation clearing and ground disturbance, where possible.
- Site linear features (e.g., trails, roads, rivers) to cross other linear features at right angles whenever possible to minimize viewing area and duration.
- Site and design structures and roads to minimize and balance cuts and fills and to preserve existing rocks, vegetation, and drainage patterns to the maximum extent possible.

- Use appropriately colored materials for structures or appropriate stains and coatings to blend with the project's backdrop. Refer to the Standard Environmental Colors chart available from the BLM.
- Use non-reflective or low-reflectivity materials, coatings, or paints whenever possible.
- Paint grouped structures the same color to reduce visual complexity and color contrast.
- Design and install efficient facility lighting so that the minimum amount of lighting required for safety and security is provided but not exceeded and so that upward light scattering (light pollution) is minimized. This may include, for example, installing shrouds to minimize light from straying off-site, properly directing light to only illuminate necessary areas, and installing motion sensors to only illuminate areas when necessary.
- Site construction staging areas and laydown areas outside of the viewsheds of publically accessible vantage points and visually sensitive areas, where possible, including siting in swales, around bends, and behind ridges and vegetative screens.
- Discuss visual impact mitigation objectives and activities with equipment operators prior to commencement of construction activities.
- Mulch or scatter slash from vegetation removal and spread it to cover fresh soil disturbances or, if not possible, bury or compost slash.
- If slash piles are necessary, stage them out of sight of sensitive viewing areas.
- Avoid installing gravel and pavement where possible to reduce color and texture contrasts with existing landscape.
- Use excess fill to fill uphill-side swales resulting from road construction in order to reduce unnatural-appearing slope interruption and to reduce fill piles.
- Avoid downslope wasting of excess fill material.
- Round road-cut slopes, vary cut and fill pitch to reduce contrasts in form and line, and vary slope to preserve specimen trees and nonhazardous rock outcroppings.
- Leave planting pockets on slopes where feasible.
- Combine methods of re-establishing native vegetation through seeding, planting of nursery stock, transplanting of local vegetation within the proposed disturbance areas and staging of construction enabling direct transplanting.

- Revegetate with native vegetation establishing a composition consistent with the form, line, color, and texture of the surrounding undisturbed landscape."
- Provide benches in rock cuts to accent natural strata.
- Use split-face rock blasting to minimize unnatural form and texture resulting from blasting.
- Segregate topsoil from cut and fill activities and spread it on freshly disturbed areas to reduce color contrast and to aid rapid revegetation.
- Bury utility cables in or adjacent to the road where feasible.
- Minimize signage and paint or coat reverse sides of signs and mounts to reduce color contrast with existing landscape.
- Prohibit trash burning; store trash in containers to be hauled off-site for disposal.
- Undertake interim restoration during the operating life of the project as soon as possible after disturbances. During road maintenance activities, avoid blading existing forbs and grasses in ditches and along roads.
- Randomly scarify cut slopes to reduce texture contrast with existing landscape and to aid in revegetation.
- Cover disturbed areas with stockpiled topsoil or mulch, and revegetate with a mix of native species selected for visual compatibility with existing vegetation.
- Restore rocks, brush, and natural debris whenever possible to approximate preexisting visual conditions.

Air Quality and Climate

- The operator will prepare and submit to the agency an Equipment Emissions Mitigation Plan for managing diesel exhaust, An Equipment Emissions Mitigation Plan will identify actions to reduce diesel particulate, carbon monoxide, hydrocarbons, and nitrogen oxides associated with construction and drilling activities. The Equipment Emissions Mitigation Plan will require that all drilling/construction-related engines are maintained and operated as follows:
    - Are tuned to the engine manufacturer's specification in accordance with an appropriate time frame.
    - Do not idle for more than five minutes (unless, in the case of certain drilling engines, it is necessary for the operating scope).

- Are not tampered with in order to increase engine horsepower.
- Include particulate traps, oxidation catalysts, and other suitable control devices on all drilling/construction equipment used at the project site.
- Use diesel fuel having a sulfur content of 15 parts per million or less, or other suitable alternative diesel fuel, unless such fuel cannot be reasonably procured in the market area.
- Include control devices to reduce air emissions. The determination of which equipment is suitable for control devices should be made by an independent Licensed Mechanical Engineer. Equipment suitable for control devices may include drilling equipment, work over and service rigs, mud pumps, generators, compressors, graders, bulldozers, and dump trucks.

Health and Safety

- Operators will develop a hazardous materials management plan addressing storage, use, transportation, and disposal of each hazardous material anticipated to be used at the site. The plan will identify all hazardous materials that would be used, stored, or transported at the site. It will establish inspection procedures, storage requirements, storage quantity limits, inventory control, nonhazardous product substitutes, and disposition of excess materials. The plan will also identify requirements for notices to federal and local emergency response authorities and include emergency response plans.
- Operators will develop a waste management plan identifying the waste streams that are expected to be generated at the site and addressing hazardous waste determination procedures, waste storage locations, waste-specific management and disposal requirements, inspection procedures, and waste minimization procedures. This plan will address all solid and liquid wastes that may be generated at the site.
- Operators will develop a spill prevention and response plan identifying where hazardous materials and wastes are stored on site, spill prevention measures to be implemented, training requirements, appropriate spill response actions for each material or waste, the locations of spill response kits on site, a procedure for ensuring that the spill response kits are adequately stocked at all times, and procedures for making timely notifications to authorities.

- A safety assessment will be conducted to describe potential safety issues and the means that would be taken to mitigate them, including issues such as site access, construction, safe work practices, security, heavy equipment transportation, traffic management, emergency procedures, and fire control.
- A health and safety program will be developed to protect both workers and the general public during construction and operation of geothermal projects.
- Regarding occupational health and safety, the program will identify all applicable federal and state occupational safety standards; establish safe work practices for each task (e.g., requirements for personal protective equipment and safety harnesses; Occupational Safety and Health Administration [OSHA] standard practices for safe use of explosives and blasting agents; and measures for reducing occupational electric and magnetic fields [EMF] exposures); establish fire safety evacuation procedures; and define safety performance standards (e.g., electrical system standards and lightning protection standards). The program will include a training program to identify hazard training requirements for workers for each task and establish procedures for providing required training to all workers. Documentation of training and a mechanism for reporting serious accidents to appropriate agencies will be established.
- Regarding public health and safety, the health and safety program will establish a safety zone or setback for generators from residences and occupied buildings, roads, ROWs, and other public access areas that is sufficient to prevent accidents resulting from the operation of generators. It will identify requirements for temporary fencing around staging areas, storage yards, and excavations during construction or rehabilitation activities. It will also identify measures to be taken during the operation phase to limit public access to hazardous facilities (e.g., permanent fencing would be installed only around electrical substations, and facility access doors would be locked).
- Operators will consult with local planning authorities regarding increased traffic during the construction phase, including an assessment of the number of vehicles per day, their size, and type. Specific issues of concern (e.g., location of school bus routes and stops) will be identified and addressed in the traffic management plan.
- Operators will develop a fire management strategy to implement measures to minimize the potential for a human-caused fire.

Livestock Grazing

- The operator will coordinate with livestock operators to minimize impacts to livestock operations.

Noxious Weeds and Pesticides

- Operators will develop a plan for control of noxious weeds and invasive species, which could occur as a result of new surface disturbance activities at the site. The most recent recommendations at the state and local level should be incorporated into any operating plan for the geothermal exploration and development. The plan will address monitoring, education of personnel on weed identification, the manner in which weeds spread, and methods for treating infestations. The use of certified weed-free mulching will be required. If trucks and construction equipment are arriving from locations with known invasive vegetation problems, a controlled inspection and cleaning area will be established to visually inspect construction equipment arriving at the project area and to remove and collect seeds that may be adhering to tires and other equipment surfaces.
- If pesticides are used on the site, an integrated pest management plan will be developed to ensure that applications would be conducted within the framework of all Federal, State, and local laws and regulations and entail only the use of EPA-registered pesticides.

Vegetation and Fish and Wildlife

- The operator shall prepare a habitat restoration plan to avoid (if possible), minimize, or mitigate negative impacts on vulnerable wildlife while maintaining or enhancing habitat values for other species. The plan will identify revegetation, soil stabilization, and erosion reduction measures that will be implemented to ensure that all temporary use areas are restored. The plan will require that restoration occur as soon as possible after completion of activities to reduce the amount of habitat converted at any one time and to speed up the recovery to natural habitats.

CONSTRUCTION

Traffic Management

- Traffic will be restricted to the roads developed for the project. Use of other unimproved roads will be restricted to emergency situations.
- Signs will be placed along roads to identify speed limits, travel restrictions, and other standard traffic control information. Signs directing vehicles to alternative park access and parking will be posted in the event construction temporarily obstructs recreational

parking areas near trailheads. Whenever active work is being performed, the area will be posted with "construction ahead" signs on any adjacent access roads or trails that might be affected.

- Project personnel and contractors will be instructed and required to adhere to speed limits commensurate with road types, traffic volumes, vehicle types, and site-specific conditions, to ensure safe and efficient traffic flow and to reduce wildlife collisions and disturbance and fugitive dust.
- When practical, construction activities will be avoided during high recreational use periods.

Roads & Pads

- The operator will obtain agency authorization prior to borrowing soil or rock material from agency lands.
- Road use will be restricted during the wet season if road surfacing is not adequate to prevent soil displacement, rutting, etc., and resultant stream sedimentation.
- Access roads and on-site roads will be surfaced with aggregate materials where necessary to provide a stable road surface, support anticipated traffic, reduce fugitive dust, and prevent erosion,
- Dust abatement techniques will be used before and during surface clearing, excavation, or blasting activities. Dust abatement techniques will be used on unpaved, unvegetated surfaces to minimize fugitive dust. Speed limits (e.g., 25 mph [40 kph]) will be posted and enforced to reduce fugitive dust. Construction materials and stockpiled soils will be covered if they are a source of fugitive dust.
- Culvert outlets will be rip-rapped to dissipate water energy at the outlet and reduce erosion. Catch basins, roadway ditches, and culverts will be cleaned and maintained regularly.

Pipelines

- Pipelines constructed above ground due to thermal gradient induced expansion and contraction will rest on cradles above ground level, allowing small animals to pass underneath. Projects should be analyzed to ensure adequate passage for all wildlife species. The pipeline will be raised higher to allow wildlife passage where needed. Because pipeline corridors through certain habitat types can alter local predator-prey dynamics by providing predators with lines of sight and travel corridors, large projects should be analyzed to ensure there will be no significant changes to predator-prey balance.

Utilities

- Underground utilities will be installed to minimize the amount of open trenches at any given time, keeping trenching and backfilling crews close together. Avoid leaving trenches open overnight. Where trenches cannot be back-filled immediately, escape ramps should be constructed at least every 100 feet.

SPECIFIC RESOURCES

Cultural and Paleontological Resources

- Unexpected discovery of cultural or paleontological resources during construction will be brought to the attention of the responsible BLM authorized officer immediately. Work will be halted in the vicinity of the find to avoid further disturbance to the resources while they are being evaluated and appropriate mitigation measures are being developed.

Noise

- The operator will take measurements to assess the existing background noise levels at a given site and compare them with the anticipated noise levels associated with the proposed project.
- Within [2] miles of existing, occupied residences, geothermal well drilling or major facility construction operations will be restricted to non-sleeping hours (7:00 am to 10:00 pm).
- All equipment will have sound-control devices no less effective than those provided on the original equipment. All construction equipment used will be adequately muffled and maintained.
- All stationary construction equipment (i.e., compressors and generators) will be located as far as practicable from nearby residences.
- If blasting or other noisy activities are required during the construction period, nearby residents will be notified by the operator at least 1 hour in advance.
- Explosives will be used only within specified times and at specified distances from sensitive wildlife or streams and lakes, as established by the federal and state agencies.

Noxious Weeds and Pesticides

- The use of certified, weed-free mulch will be required when stabilizing areas of disturbed soil.
- If trucks and construction equipment are arriving from locations with known invasive vegetation problems, a controlled inspection and cleaning area will be established to visually inspect construction

equipment arriving at the project area and to remove and collect seeds that may be adhering to tires and other equipment surfaces.

- Fill materials and road surfacing materials that originate from areas with known invasive vegetation problems will not be used.
- Revegetation, habitat restoration and weed control activities will be initiated as soon as possible after construction activities are completed.
- Use of pesticides must be approved by the agency. Pesticide use will be limited agency approved pesticides and will only be applied in accordance with label and application permit directions and stipulations for terrestrial and aquatic applications.

Waste Management

- All refueling will occur in a designated fueling area that includes a temporary berm to limit the spread of any spill.
- Drip pans will be used during refueling to contain accidental releases.
- Drip pans will be used under fuel pump and valve mechanisms of any bulk fueling vehicles parked at the construction site.
- Any containers used to collect liquids will be enclosed or screened to prevent access to contaminants by wildlife, livestock, and migratory birds.
- Spills will be immediately addressed per the spill management plan, and soil cleanup and removal initiated as soon as feasible.

Wild Horses and Burros

- The operator will ensure employees, contractors, and site visitors avoid harassment and disturbance of wild horses and burros, especially during reproductive (e.g., breeding and birthing) seasons. In addition, any pets will be controlled to avoid harassment and disturbance of wild horses and burros.
- Observations of potential problems regarding wild horses or burros, including animal mortality, will be immediately reported to the agency.

Wildlife

- The operator will ensure that employees, contractors, and site visitors avoid harassment and disturbance of wildlife, especially during reproductive (e.g., courtship and nesting) seasons. In addition, pets will be controlled or excluded to avoid harassment and disturbance of wildlife.

- Ponds, tanks and impoundments (including but not limited to drill pits) containing liquids can present hazards to wildlife. Any liquids contaminated by substances which may be harmful due to toxicity, or fouling of the fur or feathers (detergents, oils), should be excluded from wildlife access by fencing, netting or covering at all times when not in active use. Liquids at excessive temperature should likewise be excluded. If exclusion is not feasible, such as a large pond, a hazing program based on radar or visual detection, in conjunction with formal monitoring, should be implemented. Clean water impoundments can also present a trapping hazard if they are steep-sided or lined with smooth material. All pits, ponds and tanks should have escape ramps functional at any reasonably anticipated water level, down to almost empty. Escape ramps can take various forms depending on the configuration of the impoundment. Earthen pits may be constructed with one side sloped 3:1 or greater lined ponds can use textured material; straight-sided tanks can be fitted with expanded metal escape ladders.

OPERATIONS/UTILIZATION

- "Good housekeeping" procedures will be developed by the operator to ensure that during all phases of exploration and operation the site will be kept clean of noxious weeds, debris, litter, garbage, fugitive trash or waste, and graffiti. Scrap heaps and dumps are prohibited. Storage yards are to be minimized to that which is absolutely necessary.

RECLAMATION

The following objectives, performance standards, and recommended reclamation BMPs and mitigation measures are based on the standards and guidelines found in the BLM and Forest Service Gold Book, 4th Edition, updated in 2007.

[ ] Indicates site-specific values to be filled in by the authorized officer.

Reclamation Objectives

- The objective of <u>interim reclamation</u> is to restore vegetative cover and a portion of the landform sufficient to maintain healthy, biologically active topsoil; control erosion; and minimize habitat, visual, and forage loss during the life of the well or facilities.
- The long-term objective of <u>final reclamation</u> is to return the land to a condition approximating that which existed prior to disturbance. This includes restoration of the landform and natural vegetative community, hydrologic systems, visual resources, and wildlife habitats. To ensure that the long-term objective will be reached through human and natural processes, actions will be taken to

ensure standards are met for site stability, visual quality, hydrological functioning, and vegetative productivity.

Reclamation Performance Standards

The following reclamation performance standards will be met:

Interim Reclamation – Includes disturbed areas that may be redisturbed during operations and will be redisturbed at final reclamation to achieve restoration of the original landform and a natural vegetative community.

- Will be judged successful when the BLM authorized officer determines that…
- Disturbed areas not needed for active, long-term production operations or vehicle travel have been recontoured, protected from erosion, and revegetated with a self-sustaining, vigorous, diverse, native (or as otherwise approved) plant community sufficient to minimize visual impacts, provide forage, stabilize soils, and impede the invasion of noxious, invasive, and non-native weeds.

Final Reclamation – Includes disturbed areas where the original landform and a natural vegetative community have been restored.

- Will be judged successful when the authorized officer determines that…
- The original landform has been restored for all disturbed areas including well pads, production facilities, roads, pipelines, and utility corridors.
- General: A self-sustaining, vigorous, diverse, native (or otherwise approved) plant community is established on the site, with a density sufficient to control erosion and invasion by non-native plants and to reestablish wildlife habitat or forage production. At a minimum, the established plant community will consist of species included in the seed mix and/or desirable species occurring in the surrounding natural vegetation.
- Specific: No single species will account for more than [30]% total vegetative composition unless it is evident at higher levels in the adjacent landscape. Permanent vegetative cover will be determined successful when the basal cover of desirable perennial species is at least [80]% of the basal cover on adjacent or nearby undisturbed areas where vegetation is in a healthy condition; or [80]% of the potential basal cover as defined in the National Resource Conservation Service Ecological Site(s) for the area. Plants must be resilient as evidenced by well-developed root systems and flowers. [Shrubs, will be well established and in a "young" age class at a

minimum (therefore, not comprised mainly of seedlings that may not survive until the following year).]

- In agricultural areas, irrigation systems and soil conditions are reestablished in such a way as to ensure successful cultivation and harvesting of crops.
- Erosion features are equal to or less than surrounding area and erosion control is sufficient so that water naturally infiltrates into the soil and gullying, headcutting, slumping, and deep or excessive rills (greater than 3 inches) are not observed.
- The site is free of State- or county-listed noxious weeds, oil field debris and equipment, and contaminated soil. Invasive and non-native weeds are controlled.

Reclamation Actions

- During initial well pad, production facility, road, pipeline, and utility corridor construction and prior to completion of the final well on the well pad, pre-interim reclamation stormwater management actions will be taken to ensure disturbed areas are quickly stabilized to control surface water flow and to protect both the disturbed and adjacent areas from erosion and siltation. This may involve construction and maintenance of temporary silt ponds, silt fences, berms, ditches, and mulching.
- When the last well on the pad has been completed, some portions of the well location will undergo interim reclamation and some portions of the well pad will usually undergo final reclamation. Most well locations will have limited areas of bare ground, such as a small area around production facilities or the surface of a rocked road. Other areas will have interim reclamation where workover rigs and fracturing tanks may need a level area to set up in the future. Some areas will undergo final reclamation where portions of the well pad will no longer be needed for production operations and can be recontoured to restore the original landform.
- The following minimum reclamation actions will be taken to ensure that the reclamation objectives and standards are met. It may be necessary to take additional reclamation actions beyond the minimum in order to achieve the Reclamation Standards.

Reclamation - General

Procedure:

- The agency will be notified 24 hours prior to commencement of any reclamation operations.

Housekeeping:

- Immediately upon well completion, the well location and surrounding areas(s) will be cleared of, and maintained free of, all debris, materials, trash, and equipment not required for production.
- No hazardous substances, trash, or litter will be buried or placed in pits. Upon well completion, any hydrocarbons in the pit will be remediated or removed.

Vegetation Clearing:

- Vegetation removal and the degree of surface disturbance will be minimized wherever possible.
- *[Example of site-specific requirement*: During vegetation clearing activities, trees and woody vegetation removed from the well pad and access road will be moved aside prior to any soil disturbing activities. Care will be taken to avoid mixing soil with the trees and woody vegetation. Trees left for wood gathering will be cut [twelve inches or less from the ground], delimbed, and the trunks, six (6) inches or more in diameter will be removed and placed either by the uphill side of the access road, or moved to the end of the road, or to a road junction for easy access for wood gatherers and to reduce vehicle traffic on the well pad. Trees with a trunk diameter less than six (6) inches and woody vegetation will be used to trap sediment, slow runoff, or scattered on reclaimed areas to stabilize slopes, control erosion, and improve visual resources.]

Topsoil Management:

- Operations will disturb the minimum amount of surface area necessary to conduct safe and efficient operations. When possible, equipment will be stored and operated on top of vegetated ground to minimize surface disturbance.
- In areas to be heavily disturbed, the top [eight (8)] inches of soil material, will be stripped and stockpiled around the perimeter of the well location to control run-on and run-off, and to make redistribution of topsoil more efficient during interim reclamation. Stockpiled topsoil may include vegetative material. Topsoil will be clearly segregated and stored separately from subsoils.
- Earthwork for interim and final reclamation will be completed within 6 months of well completion or plugging unless a delay is approved in writing by the BLM authorized officer.
- Salvaging and spreading topsoil will not be performed when the ground or topsoil is frozen or too wet to adequately support construction equipment. If such equipment creates ruts in excess of four (4) inches deep, the soil will be deemed too wet.

- No major depressions will be left that would trap water and cause ponding.

Seeding:

- Seedbed Preparation. Initial seedbed preparation will consist of recontouring to the appropriate interim or final reclamation standard. All compacted areas to be seeded will be ripped to a minimum depth of 18 inches with a minimum furrow spacing of 2 feet, followed by recontouring the surface and then evenly spreading the stockpiled topsoil. Prior to seeding, the seedbed will be scarified and left with a rough surface.
- If broadcast seeding is to be used and is delayed, final seedbed preparation will consist of contour cultivating to a depth of 4 to 6 inches within 24 hours prior to seeding, dozer tracking, or other imprinting in order to loosen up the soil and create seed germination micro-sites.
- Seed Application. Seeding will be conducted no more than 24 hours following completion of final seedbed preparation. A certified weed-free seed mix designed by BLM (shown below) to meet reclamation standards will be used. The following seed mix and rates will be used on all disturbed surfaces, including pipelines and road cut & fill slopes:

Species of Seed	Cultivar	App. Rate PLS (lbs/ac)
		Total:

- The application rate shown in the table is based on [45] pure live seeds (PLS) per square foot, drill-seeded to a depth of 0.25 to 0.5 inch, which is the method that will be used where feasible. [However, shrub species will be seeded during the winter on the ground surface or preferably on top of snow.] In areas that will not be drill-seeded, the seed mix will be broadcast-seeded at twice the application rate shown in the table and covered no more than

0.25 inch deep with a harrow, drag bar, or roller or will be broadcast-seeded into imprints, such as fresh dozer cleat marks.

- No seeding will occur from [May 15 to September 15]. Fall seeding is preferred and will be conducted after [September 15] and prior to ground freezing. [Shrub species will be seeded separately and will be seeded during the winter.] Spring seeding will be conducted after the frost leaves the ground and no later than [May 15].

Erosion Control and Mulching:

- Mulch, silt fencing, waddles, hay bales, and other erosion control devices will be used on areas at risk of soil movement from wind and water erosion.
- Mulch will be used if necessary to control erosion, create vegetation micro-sites, and retain soil moisture and may include hay, small-grain straw, wood fiber, live mulch, cotton, jute, or synthetic netting. Mulch will be free from mold, fungi, and certified free of noxious or invasive weed seeds.
- If straw mulch is used, it will contain fibers long enough to facilitate crimping and provide the greatest cover.

Pit Closure:

- Reserve pits will be closed and backfilled within **sixty (60)** days of release of the rig. All reserve pits remaining open after **sixty (60)** days will require written authorization of the authorized officer. Immediately upon well completion, any hydrocarbons or trash in the pit will be removed. Pits will be allowed to dry, be pumped dry, or solidified in-situ prior to backfilling.
- Following completion activities, pit liners will be completely removed or removed down to the solids level and disposed of at an approved landfill, or treated to prevent their reemergence to the surface and interference with long-term successful revegetation. If it was necessary to line the pit with a synthetic liner, the pit will not be trenched (cut) or filled (squeezed) while containing fluids. When dry, the pit will be backfilled with a minimum of 5 feet of soil material. In relatively flat areas the pit area will be slightly mounded above the surrounding grade to allow for settling and to promote surface drainage away from the backfilled pit.

Management of Invasive, Noxious, and Non-Native Species:

- All reclamation equipment will be cleaned prior to use to reduce the potential for introduction of noxious weeds or other undesirable non-native species.
- An intensive weed monitoring and control program will be implemented prior to site preparation for planting and will continue

until interim or final reclamation is approved by the authorized officer.

- Monitoring will be conducted at least annually during the growing season to determine the presence of any invasive, noxious, and non-native species. Invasive, noxious, and non-native species that have been identified during monitoring will be promptly treated and controlled. A Pesticide Use Proposal (PUP) will be submitted to the BLM for approval prior to the use of herbicides.

Interim Reclamation Procedures - Additional

Recontouring:

- Interim reclamation actions will be completed no later than 6 months from when the final well on the location has been completed, weather permitting. The portions of the cleared well site not needed for active operational and safety purposes will be recontoured to the original contour if feasible, or if not feasible, to an interim contour that blends with the surrounding topography as much as possible. Sufficient semi-level area will remain for setup of a workover rig and to park equipment. In some cases, rig anchors may need to be pulled and reset after recontouring to allow for maximum interim reclamation.
- If the well is a producer, the interim cut and fill slopes prior to re-seeding will not be steeper than a 3:1 ratio, unless the adjacent native topography is steeper. Note: Constructed slopes may be much steeper during drilling, but will be recontoured to the above ratios during interim reclamation.
- Roads and well production equipment will be placed on location so as to permit maximum interim reclamation of disturbed areas. If equipment is found to interfere with the proper interim reclamation of disturbed areas, the equipment will be moved so proper recontouring and revegetation can occur.

Application of Topsoil & Revegetation:

- Topsoil will be evenly respread and aggressively revegetated over the entire disturbed area not needed for all-weather operations including road cuts & fills and to within a few feet of the production facilities, unless an all-weather, surfaced, access route or small "teardrop" turnaround is needed on the well pad.
- In order to inspect and operate the well or complete workover operations, it may be necessary to drive, park, and operate equipment on restored, interim vegetation within the previously disturbed area. Damage to soils and interim vegetation will be repaired and reclaimed following use. To prevent soil compaction,

under some situations, such as the presence of moist, clay soils, the vegetation and topsoil will be removed prior to workover operations and restored and reclaimed following workover operations.

Visual Resources Mitigation for Reclamation:

- Trees, if present, and vegetation will be left along the edges of the pads whenever feasible to provide screening.
- To help mitigate the contrast of recontoured slopes, reclamation will include measures to feather cleared lines of vegetation and to save and redistribute cleared trees, debris, and rock over recontoured cut and fill slopes.
- To reduce the view of production facilities from visibility corridors and private residences, facilities will not be placed in visually exposed locations (such as ridgelines and hilltops).
- Production facilities will be clustered and placed away from cut slopes and fill slopes to allow the maximum recontouring of the cut and fill slopes.
- All long-term above ground structures will be painted [Covert Green] (from the "Standard Environmental Colors" chart) to blend with the natural color of the late summer landscape background.

Final Reclamation Procedures – Additional

- Final reclamation actions will be completed within 6 months of well plugging, weather permitting.
- All disturbed areas, including roads, pipelines, pads, production facilities, and interim reclaimed areas will be recontoured to the contour existing prior to initial construction or a contour that blends indistinguishably with the surrounding landscape. Resalvaged topsoil will be respread evenly over the entire disturbed site to ensure successful revegetation. To help mitigate the contrast of recontoured slopes, reclamation will include measures to feather cleared lines of vegetation and to save and redistribute cleared trees, woody debris, and large rocks over recontoured cut and fill slopes.
- Water breaks and terracing will only be installed when absolutely necessary to prevent erosion of fill material. Water breaks and terracing are not permanent features and will be removed and reseeded when the rest of the site is successfully revegetated and stabilized.
- If necessary to ensure timely revegetation, the pad will be fenced to BLM standards to exclude livestock grazing for the first two growing seasons or until seeded species become firmly established,

whichever comes later. Fencing will meet standards found on page 18 of the BLM/FS Gold Book, 4th Edition, or will be fenced with operational electric fencing.

- Final abandonment of pipelines and flowlines will involve flushing and properly disposing of any fluids in the lines. All surface lines and any lines that are buried close to the surface that may become exposed in the foreseeable future due to water or wind erosion, soil movement, or anticipated subsequent use, must be removed. Deeply buried lines may remain in place unless otherwise directed by the authorized officer.

Reclamation Monitoring and Final Abandonment Approval

- Reclaimed areas will be monitored annually. Actions will be taken to ensure that reclamation standards are met as quickly as reasonably practical.
- Reclamation monitoring will be documented in an annual reclamation report submitted to the authorized officer by [March 1]. The report will document compliance with all aspects of the reclamation objectives and standards, identify whether the reclamation objectives and standards are likely to be achieved in the near future without additional actions, and identify actions that have been or will be taken to meet the objectives and standards. The report will also include acreage figures for: Initial Disturbed Acres; Successful Interim Reclaimed Acres; Successful Final Reclaimed Acres. Annual reports will not be submitted for sites approved by the authorized officer in writing as having met interim or final reclamation standards. Monitoring and reporting continues annually until interim or final reclamation is approved. Any time 30% or more of a reclaimed area is redisturbed, monitoring will be reinitiated.
- The authorized officer will be informed when reclamation has been completed, appears to be successful, and the site is ready for final inspection.

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APPENDIX E

REVIEW OF PALEONTOLOGICAL RESOURCE SECTIONS OF BLM RESOURCE MANAGEMENT PLANS IN THE PROJECT AREA

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APPENDIX E
REVIEW OF PALEONTOLOGICAL RESOURCE SECTIONS OF BLM RMPS IN THE PROJECT AREA

This appendix defines the potential fossil yield classification (PFYC) System (BLM-IM 2008-009) that the BLM applies to paleontological resources and includes a summary review and PFYC estimate for readily available RMPs within the project area.

Occurrences of paleontological resources are closely tied to the geologic units (i.e., formations, members, or beds) that contain them. The probability for finding paleontological resources can be broadly predicted from the geologic units present at or near the surface. Therefore, geologic mapping can be used for assessing the potential for the occurrence of paleontological resources.

Using the Potential Fossil Yield Classification (PFYC) system, geologic units are classified based on the relative abundance of vertebrate fossils or scientifically significant invertebrate or plant fossils and their sensitivity to adverse impacts, with a higher class number indicating a higher potential. This classification is applied to the geologic formation, member, or other distinguishable unit, preferably at the most detailed mappable level. It is not intended to be applied to specific paleontological localities or small areas within units. Although significant localities may occasionally occur in a geologic unit, a few widely scattered important fossils or localities do not necessarily indicate a higher class; instead, the relative abundance of significant localities is intended to be the major determinant for the class assignment.

The PFYC system is meant to provide baseline guidance for predicting, assessing, and mitigating paleontological resources. The classification should be considered at an intermediate point in the analysis, and should be used to assist in determining the need for further mitigation assessment or actions.

The descriptions for the classes below are written to serve as guidelines rather than as strict definitions. Knowledge of the geology and the paleontological potential for individual units or preservational conditions should be considered when determining the appropriate class assignment. Assignments are best made by collaboration between land managers and knowledgeable researchers.

Class 1 – **Very Low**. Geologic units that are not likely to contain recognizable fossil remains.

- Units that are igneous or metamorphic, excluding reworked volcanic ash units.
- Units that are Precambrian in age or older.

(1) Management concern for paleontological resources in Class 1 units is usually negligible or not applicable.

(2) Assessment or mitigation is usually unnecessary except in very rare or isolated circumstances.

The probability for impacting any fossils is negligible. Assessment or mitigation of paleontological resources is usually unnecessary. The occurrence of significant fossils is non-existent or extremely rare.

Class 2 – **Low**. Sedimentary geologic units that are not likely to contain vertebrate fossils or scientifically significant nonvertebrate fossils.

- Vertebrate or significant invertebrate or plant fossils not present or very rare.
- Units that are generally younger than 10,000 years before present.
- Recent aeolian deposits.
- Sediments that exhibit significant physical and chemical changes (i.e., diagenetic alteration).

(1) Management concern for paleontological resources is generally low.

(2) Assessment or mitigation is usually unnecessary except in rare or isolated circumstances.

The probability for impacting vertebrate fossils or scientifically significant invertebrate or plant fossils is low. Assessment or mitigation of paleontological resources is not likely to be necessary. Localities containing important resources may exist, but would be rare and would not influence the classification. These important localities would be managed on a case-by-case basis.

Class 3 – **Moderate** or **Unknown**. Fossiliferous sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence; or sedimentary units of unknown fossil potential.

- Often marine in origin with sporadic known occurrences of vertebrate fossils.
- Vertebrate fossils and scientifically significant invertebrate or plant fossils known to occur intermittently; predictability known to be low.

  (or)
- Poorly studied and/or poorly documented. Potential yield cannot be assigned without ground reconnaissance.

Class 3a – **Moderate Potential.** Units are known to contain vertebrate fossils or scientifically significant nonvertebrate fossils, but these occurrences are widely scattered. Common invertebrate or plant fossils may be found in the area, and opportunities may exist for hobby collecting. The potential for a project to be sited on or impact a significant fossil locality is low, but is somewhat higher for common fossils.

Class 3b – **Unknown Potential.** Units exhibit geologic features and preservational conditions that suggest significant fossils could be present, but little information about the paleontological resources of the unit or the area is known. This may indicate the unit or area is poorly studied, and field surveys may uncover significant finds. The units in this Class may eventually be placed in another Class when sufficient survey and research is performed. The unknown potential of the units in this Class should be carefully considered when developing any mitigation or management actions.

(1) Management concern for paleontological resources is moderate; or cannot be determined from existing data.

(2) Surface-disturbing activities may require field assessment to determine appropriate course of action.

This classification includes a broad range of paleontological potential. It includes geologic units of unknown potential, as well as units of moderate or infrequent occurrence of significant fossils. Management considerations cover a broad range of options as well, and could include pre-disturbance surveys, monitoring, or avoidance. Surface-disturbing activities will require sufficient assessment to determine whether significant paleontological resources occur in the area of a proposed action, and whether the action could affect the paleontological resources. These units may contain areas that would be appropriate to designate as hobby collection areas due to the higher occurrence of common fossils and a lower concern about affecting significant paleontological resources.

Class 4 – **High**. Geologic units containing a high occurrence of significant fossils. Vertebrate fossils or scientifically significant invertebrate or plant fossils are known to occur and have been documented, but may vary in occurrence and predictability. Surface disturbing activities may adversely affect paleontological resources in many cases.

Class 4a – Unit is exposed with little or no soil or vegetative cover. Outcrop areas are extensive with exposed bedrock areas often larger than two acres. Paleontological resources may be susceptible to adverse impacts from surface disturbing actions. Illegal collecting activities may impact some areas.

Class 4b – These are areas underlain by geologic units with high potential but have lowered risks of human-caused adverse impacts and/or lowered risk of natural degradation due to moderating circumstances. The bedrock unit has high potential, but a protective layer of soil, thin alluvial material, or other conditions may lessen or prevent potential impacts to the bedrock resulting from the activity.

- Extensive soil or vegetative cover; bedrock exposures are limited or not expected to be impacted.
- Areas of exposed outcrop are smaller than two contiguous acres.
- Outcrops form cliffs of sufficient height and slope so that impacts are minimized by topographic conditions.
- Other characteristics are present that lower the vulnerability of both known and unidentified paleontological resources.

(1) Management concern for paleontological resources in Class 4 is moderate to high, depending on the proposed action.

(2) A field survey by a qualified paleontologist is often needed to assess local conditions.

(3) Management prescriptions for resource preservation and conservation through controlled access or special management designation should be considered.

(4) Class 4 and Class 5 units may be combined as Class 5 for broad applications, such as planning efforts or preliminary assessments, when geologic mapping at an appropriate scale is not available. Resource assessment, mitigation, and other management considerations are similar at this level of analysis, and impacts and alternatives can be addressed at a level appropriate to the application.

The probability for impacting significant paleontological resources is moderate to high, and is dependent on the proposed action. Mitigation considerations must include assessment of the disturbance, such as removal or penetration of protective surface alluvium or soils, potential for future accelerated erosion, or increased ease of access resulting in greater looting potential. If impacts to significant fossils can be anticipated, on-the-ground surveys prior to authorizing the surface disturbing action will usually be necessary. On-site monitoring or spot-checking may be necessary during construction activities.

Class 5 – **Very High**. Highly fossiliferous geologic units that consistently and predictably produce vertebrate fossils or scientifically significant invertebrate or plant fossils, and that are at risk of human-caused adverse impacts or natural degradation.

Class 5a – Unit is exposed with little or no soil or vegetative cover. Outcrop areas are extensive with exposed bedrock areas often larger than two contiguous acres. Paleontological resources are highly susceptible to adverse impacts from surface disturbing actions. Unit is frequently the focus of illegal collecting activities.

Class 5b – These are areas underlain by geologic units with very high potential but have lowered risks of human-caused adverse impacts and/or lowered risk of natural degradation due to moderating circumstances. The bedrock unit has very high potential, but a protective layer of soil, thin alluvial material, or other conditions may lessen or prevent potential impacts to the bedrock resulting from the activity.

- Extensive soil or vegetative cover; bedrock exposures are limited or not expected to be impacted.
- Areas of exposed outcrop are smaller than two contiguous acres.
- Outcrops form cliffs of sufficient height and slope so that impacts are minimized by topographic conditions.
- Other characteristics are present that lower the vulnerability of both known and unidentified paleontological resources.

(1) Management concern for paleontological resources in Class 5 areas is high to very high.

(2) A field survey by a qualified paleontologist is usually necessary prior to surface disturbing activities or land tenure adjustments. Mitigation will often be necessary before and/or during these actions.

(3) Official designation of areas of avoidance, special interest, and concern may be appropriate.

The probability for impacting significant fossils is high. Vertebrate fossils or scientifically significant invertebrate fossils are known or can reasonably be expected to occur in the impacted area. On-the-ground surveys prior to authorizing any surface disturbing activities will usually be necessary. On-site monitoring may be necessary during construction activities.

Table E-1
Review of RMPs and PFYC Estimates

State	Field Office/District	Area	Date of RMP	Paleontological Resources Analyzed?	PFYC Class Estimate[1]	Comments
AK	Anchorage	Bay	July 2006	yes	2, 4 and 5	Short section with no specific information. Paleontological resources assessed by Lindsey (1986).
AK	Anchorage	Ring of Fire	June 2006	yes	2, 4 and 5	Moderately thorough description (by sub-area) of paleontological resources and previous work.
AK	Fairbanks and Anchorage	Kobuk-Seward	February 2006	yes	cannot be determined	Short section with little specific information. Paleontological resources assessed by Lindsey (1986).
AK	Glennallen	East Alaska	April 2006	yes	3, 4 and 5	Moderately thorough description (by sub-area) of paleontological resources and previous work.
AZ	Arizona Strip	Arizona Strip	January 2007	Appendix 3b	2, 3, 4 and 5	Virtually no paleontologic discussion within the AE chapter. Appendix 3B contains information on paleontological resource occurrences, and a geologic map is provided (map 3.10). Figures 3.1 and 3.2 are stratigraphic sections.
AZ	Arizona Strip	Vermillion Cliffs and Grand Canyon-Parashant Nat. Mons.	January 2007	yes	2, 3, 4 and 5	Essentially the same paleontological report as the Arizona Strip RMP
AZ	Lake Havasu	Arizona and California	May 2007	yes	cannot be determined	Paleontological resources are discussed, but no specific details of fossils, geologic formations, or paleontological sensitivity is included. Paleontological resource classification system used is not the current PFYC. Insufficient information is provided to assess paleontological sensitivity or to provide PFYC designations. Paleontology section written by an archaeologist.
AZ	Tucson	Ironwood Forest Nat. Mon.	March 2007	yes	1 and 2	Brief paleontological resource section that concludes that only PFYC class 1 and 2 are present. Paleontological resources analyzed by Cultural Resource and Geological Staff (not by a paleontologist). Insufficient information is included to properly assess paleontological sensitivity.

Table E-1
Review of RMPs and PFYC Estimates

State	Field Office/District	Area	Date of RMP	Paleontological Resources Analyzed?	PFYC Class Estimate[1]	Comments
AZ	Yuma	Arizona and California	December 2006	yes	2, 3, 4 and 5	Broad paleontological discussion with short list of known fossils provided, but no specifics on geologic formation associations, and no information about formations and their fossil occurrences. Paleontological resource evaluation conducted by a geologist/archaeologist.
CA	Arcata	Headwaters Forest Reserve	September 2003	no	cannot be determined	No mention of paleontological resources.
CA	Arcata	King Range	November 2004	yes	cannot be determined	Short paragraph concluding that paleontological resources would not be affected, and thus are not discussed or analyzed in the RMP. Based on the geologic map provided, and the information included in the geology section, paleontologic resources may actually be affected. No paleontologist input included in RMP.
CA	Bakersfield district	Caliente Resource Area	August 2007	no	2, 3, 4 and 5	Virtually no mention of paleontological resources and no specific AE chapter provided. Fossil occurrences are mentioned within three of the 16 ACEC sections (chapter 11). These provided sufficient information to tentatively provide PFYC designations.
CA	California Desert District	South Coast Resource	June 1994	no	cannot be determined	No mention of paleontological resources.
CA	California Desert District	California Desert Conservation area	March 1999	no	cannot be determined	Paleontological resources discussed in the context of "cultural and paleontological resources." However, no specific discussion of paleontological resources is provided, nor is there any mention of specific paleontological resources within the management area.
CA	Eagle Lake		May 2007	no	cannot be determined	Paleontological resources are included in the AE chapter section 3.2 (Cultural Resources and Paleontology), but no discussion of paleontology is provided, nor is there any mention of paleontological resources within the management area.

Table E-1
Review of RMPs and PFYC Estimates

State	Field Office/District	Area	Date of RMP	Paleontological Resources Analyzed?	PFYC Class Estimate[1]	Comments
CA	El Centro	Eastern San Diego Co.	February 2007	yes	cannot be determined	A paleontological resources discussion is included, but with no reference to the types of paleontological resources occurring in the management area, or to exposures of specific formations. Furthermore, the paleontological resource classification system used in this RMP is not the PFYC.
CA	Folsom	Sierra	not available	yes	cannot be determined	One short paragraph concluding that paleontological resources are limited to plant microfossils. No information about specific geologic formations is provided.
CA	Palm Springs-South Coast	Santa Rosa and San Jacinto Mnts	February 2004	no	cannot be determined	No assessment of paleontological resources.
CA	Surprise		May 2007	no	cannot be determined	Paleontological resources included in the AE chapter section 3.2 (Cultural Resources and Paleontology), but no discussion of paleontological resources is provided, nor is there any mention of paleontological resources within the management area.
CA	Ukiah District	Redding resource	July 1992	no	cannot be determined	No assessment of paleontological resources.
CO		McInnis Canyon/ Colorado Canyons Conservation area	July 2004	yes	2, 3, 4 and 5	General description of paleontological resources in the area with some reference to fossil types and mapped formations. No citations of primary literature used in analysis.
CO	Canon City District	Northeast Resource area	May 1985	no	cannot be determined	Paleontological resources discussed in the context of management and mitigation. However, there is no specific discussion about, nor specific reference to, fossils or formations.
CO	Canon City District	Royal Gorge	January 1995	no	cannot be determined	Paleontological resources discussed in the context of management and mitigation. However, no specific discussion about, nor specific reference to, fossils or formations is provided.

Table E-1
Review of RMPs and PFYC Estimates

State	Field Office/District	Area	Date of RMP	Paleontological Resources Analyzed?	PFYC Class Estimate[1]	Comments
CO	Canon City District	San Luis	September 1991	no	cannot be determined	Paleontological resources discussed in the context of management and mitigation. However, no specific discussion about, nor specific reference to, fossils or formations is provided.
CO	Craig District	Kremmling	1983	no	cannot be determined	Paleontological resources discussed in the context of management and mitigation. However, no specific discussion about, nor specific reference to, fossils or formations is provided.
CO	Craig District	White River	July 1997	no	cannot be determined	Paleontological resources discussed in the context of management and mitigation. However, no specific discussion about, nor specific reference to, fossils or formations is provided.
CO	Glenwood Springs	Roan Plateau	August 2006	yes	2, 3, 4 and 5	Fairly complete review of paleontological resources in the field office.
CO	Montrose District	San Juan/San Miguel	December 1984	yes	2, 3, 4 and 5	Paleontological resources section is brief, and references some specific formations, but lists no specific fossil types.
CO	Montrose District	Uncompahgre	September 1998	no	cannot be determined	Paleontological resources discussed in response to public comment; however, there is no specific discussion about, nor specific reference to, fossils or formations.
CO	San Juan	Silverton	August 2004	no	cannot be determined	No assessment of paleontological resources.
ID	Twin Falls District	Craters of the Moon	July 2005	yes	2	Very general discussion of types of fossils found in various Pleistocene deposits and tree molds in lava flows.
ID	Boise district	Snake River Birds of Prey	April 2006	yes	cannot be determined	Report concluded that paleontological resources would not be impacted. No specific information on the fossils or formations in the management area is provided.
ID	Boise district	Cascade Resource area	not available	yes	cannot be determined	Very brief paleontological resources section with no specifics on fossil types or formations.
ID	Burley	Cassia	January 1985	no	cannot be determined	No assessment of paleontological resources.

Table E-1
Review of RMPs and PFYC Estimates

State	Field Office/District	Area	Date of RMP	Paleontological Resources Analyzed?	PFYC Class Estimate[1]	Comments
ID	Challis	Challis Resource area	July 1999	no	cannot be determined	Very brief (6 pages) RMP with no mention of paleontological resources other than a statement of protection.
ID	Coeur d'Alene		October 2006	yes	1 and ?5	Paleontological resources determined to be of low significance, but no reference to specific formations was made. Report references an old PFYC classification system.
ID	Cottonwood		May 2006	yes	2, 3	Brief paleontological resources section with general description of types of fossils and rocks found in the management area.
ID	Jarbidge	Jarbidge Resource Area	1987- Under revision	yes	cannot be determined	Brief review of areas of paleontological resources in the management area.
ID	Idaho Falls district	Medicine Lodge	December 1985	no	cannot be determined	No assessment of paleontological resources.
ID	Lower Snake River Dist.	Bureau	August 2001	no	cannot be determined	2 page Environmental Statement; Notice of intent
ID	Lower Snake River Dist.	Owyhee	December 1999	no	cannot be determined	No assessment of paleontological resources.
ID	Pocatello		October 2006	yes	2, 3, 4 and 5	Thorough review of paleontological resources in the management area.
ID	Salmon	Lemhi	August 2001	no	cannot be determined	No assessment of paleontological resources.
ID	Shoshone and Burley	Monument	January 1986	no	cannot be determined	No assessment of paleontological resources.
MT	Butte	Butte Resource area	June, 2007	yes	2, 3, 4 and 5	Brief review of paleontological resources in the management area.
MT	Butte District	Garnet	January 1986	no	cannot be determined	No assessment of paleontological resources.
MT	Butte District	Headwaters	November 1983	no	cannot be determined	No assessment of paleontological resources.
MT	Dillon	Dillon	March 2004	yes	2, 3, 4 and 5	Thorough review of paleontological resources in the management area.

Table E-1
Review of RMPs and PFYC Estimates

State	Field Office/District	Area	Date of RMP	Paleontological Resources Analyzed?	PFYC Class Estimate[1]	Comments
MT	Lewiston District	West HiLine	1988	yes	2, 3, 4 and 5	Brief review of paleontological resources in the management area.
MT	Lewiston District	Upper Missouri River Breaks	September 2005	yes	2, 3, 4 and 5	Brief review of paleontological resources in the management area.
MT	Miles City District	Big Dry	February 1995	yes	2, 3, 4 and 5	Thorough review of paleontological resources in the management area.
MT	Miles City District	Billings Resource area	November 1983	no	2, 3, 4 and 5	Estimated PFYC classes based on stratigraphic section (Figure 3.1) included in chapter 3 geology section.
MT	Miles City District	Powder River	December 1984	yes	2, 3, 4 and 5	Brief review of paleontological resources in the management area.
MT	Montana State Office	Judith Valley Phillips	October 1992	yes	2, 3, 4 and 5	Brief review of paleontological resources in the management area.
NM	Farmington	Farmington	December 2003	yes	cannot be determined	No details provided in the paleontological resources section.
NM	Las Cruces	McGregor Range	January 2005	yes	2, 3, 4 and 5	Brief review of paleontological resources in the management area.
NM	Las Cruces	Sierra and Otero Counties	January 2005	yes	2, 3, 4 and 5	Brief review of paleontological resources in the management area.
NM	Las Cruces	Tri County	June 2006	yes	cannot be determined	No details provided in the paleontological resources section.
NM	Pecos		not available	yes	cannot be determined	No details provided in the paleontological resources section.
NM	Rio Puerco	Kasha-Katuwe	October 2006	yes	cannot be determined	No details provided in the paleontological resources section.
NM	Roswell	Carlsbad	October 1997	no	cannot be determined	No assessment of paleontological resources.
NM	Socorro		April 2007	yes	2, 3, 4 and 5	Brief review of paleontological resources in the management area.
NM		Roswell Resource area	October 1997	no	cannot be determined	No assessment of paleontological resources.
NV	Carson City		May 2001	no	cannot be determined	No assessment of paleontological resources.

Table E-1
Review of RMPs and PFYC Estimates

State	Field Office/District	Area	Date of RMP	Paleontological Resources Analyzed?	PFYC Class Estimate[1]	Comments
NV	Elko		March 1987	no	cannot be determined	No assessment of paleontological resources.
NV	Elko	Wells	1985	no	cannot be determined	No assessment of paleontological resources.
NV	Ely		June 2005	yes	2, 3, 4 and 5	Brief review of paleontological resources in the management area.
NV	Las Vegas	Sloan Canyon	June 2006	no	cannot be determined	No assessment of paleontological resources.
NV	Las Vegas	Las Vegas	October 1998	no	can not be determined	No assessment of paleontological resources.
OR	Burns	Andrews	August 2005	yes	cannot be determined	No details provided in the paleontology section, and the BLM classification system used is not current.
OR	Lakeview	Lakeview	November 2003	no	cannot be determined	No assessment of paleontological resources.
OR	State	West Oregon	August 2007	no	cannot be determined	No assessment of paleontological resources.
OR		Upper Deschutes	not available	no	cannot be determined	No assessment of paleontological resources.
UT	Cedar City	Cedar-Beaver-Garfield-Antimony	October 1984	no	cannot be determined	No assessment of paleontological resources.
UT	Kanab	Kanab	not available	yes	2, 3, 4 and 5	Brief review of paleontological resources in the management area.
UT	Moab		August 2007	yes	cannot be determined	Lengthy paleontological resources section with very little specific information on geologic formations or fossils present
UT	Moab	San Rafael	July 1989	no	cannot be determined	No assessment of paleontological resources.
UT	Price		July 2004	yes	2, 3, 4 and 5	Brief review of paleontological resources in the management area.
UT	Richfield	House Range	October 1987	no	cannot be determined	No assessment of paleontological resources.
UT	Richfield		October 2007	yes	cannot be determined	Lengthy paleontology section with no specific information on geologic formations or fossils.

Table E-1
Review of RMPs and PFYC Estimates

State	Field Office/District	Area	Date of RMP	Paleontological Resources Analyzed?	PFYC Class Estimate[1]	Comments
UT	Richfield District	Warm Springs	April 1987	no	cannot be determined	No assessment of paleontological resources.
UT	Salt Lake	Pony Express	November 1997	no	cannot be determined	No assessment of paleontological resources.
UT	Salt Lake	Box Elder	January 1988	no	can not be determined	No assessment of paleontological resources.
UT	Vernal	Book Cliffs and Diamond Mountain	not available	yes	2, 3, 4 and 5	No detail provided in the paleontological resources section, and BLM classification used is not current. Estimated classification here based on description of physical area (geologic setting).
UT	Vernal	Book Cliffs	November 1984	yes	2, 3, 4 and 5	Brief review of paleontological resources in the management area.
UT		Grand Staircase-Escalante	February 2000	yes	2, 3, 4 and 5	Brief review of paleontological resources in the management area.
WA	Spokane District	Iceberg Point	June 1990	no	cannot be determined	No assessment of paleontological resources.
WA	Spokane District	Spokane	June 1992	no	cannot be determined	No assessment of paleontological resources.
WA	Spokane District	Yakima Firing Center	June 1993	no	cannot be determined	No assessment of paleontological resources.
WY	Casper	Platte River	July 1985	no	cannot be determined	No assessment of paleontological resources.
WY	Casper	Newcastle/ Nebraska	May 1992	no	cannot be determined	No assessment of paleontological resources.
WY	Newcastle		September 2000	no	cannot be determined	No assessment of paleontological resources.
WY	Pinedale	Snake River	April 2004	no	cannot be determined	No assessment of paleontological resources.
WY	Rawlins	Lander	June 1987	no	cannot be determined	No assessment of paleontological resources.
WY	Rawlins	Great Divide	November 1990	no	cannot be determined	No assessment of paleontological resources.

Table E-1
Review of RMPs and PFYC Estimates

State	Field Office/District	Area	Date of RMP	Paleontological Resources Analyzed?	PFYC Class Estimate[1]	Comments
WY	Rock Springs	Green River	October 1997	no	cannot be determined	No assessment of paleontological resources.
WY	Rock Springs	Kemmerer	June 1986	no	cannot be determined	No assessment of paleontological resources.
WY	Rock Springs	Pinedale	December 1988	no	cannot be determined	No assessment of paleontological resources.
WY	Worland	Grass Creek	September 1998	no	cannot be determined	No assessment of paleontological resources.
WY	Worland	Washakie	September 1988	no	cannot be determined	No assessment of paleontological resources.
WY	Worland	Cody	November 1990	no	cannot be determined	No assessment of paleontological resources.
WY		Buffalo	October 1985	no	cannot be determined	No assessment of paleontological resources.

[1] PFYC Class Estimate estimates the potential sensitivities of geologic units within each BLM field office using information provided, if any, in each RMP.

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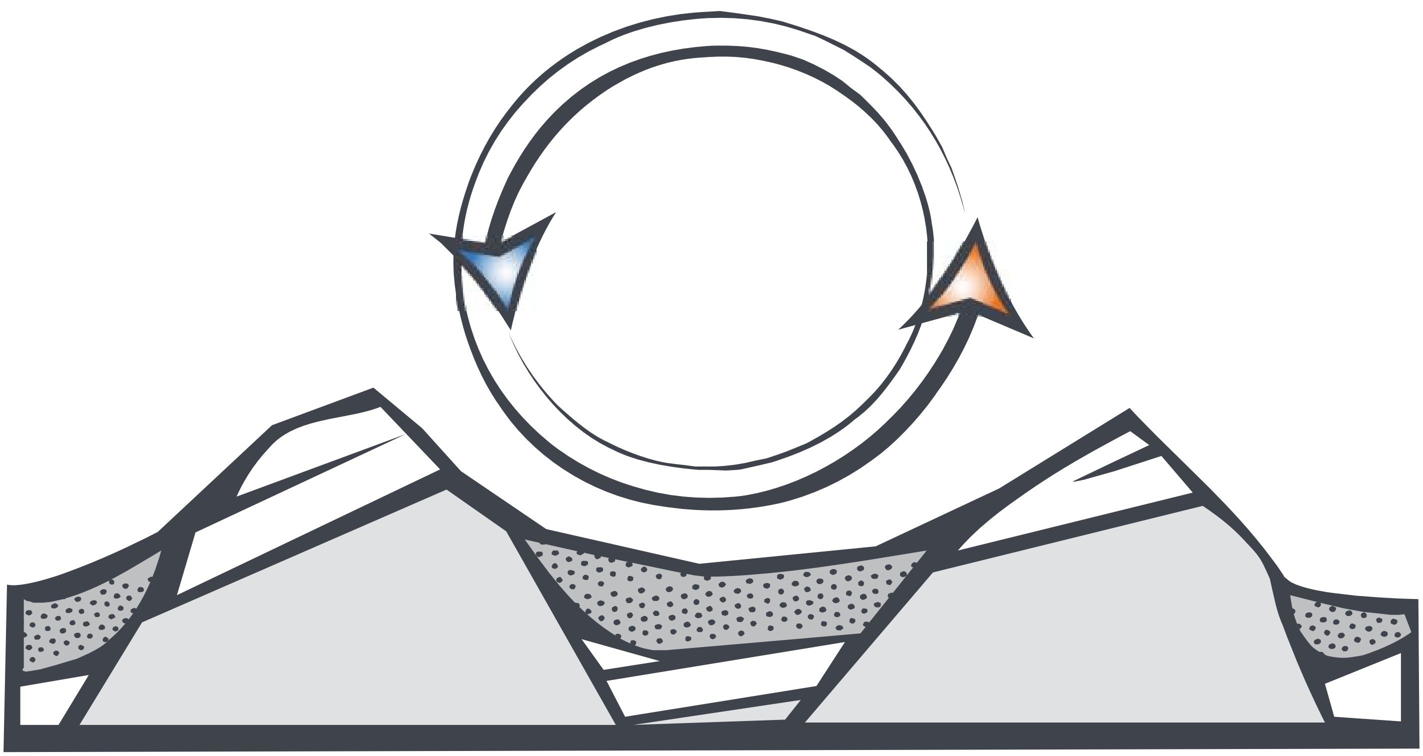

Appendix F

Hot and Warm Springs in the Project Area

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Appendix: F
Hot and Warm Springs in the Project Area

Source: US Department of Commerce, National Oceanic and Atmospheric Administration 2008

KEY:

TF = Maximum surface temperature in degrees Fahrenheit
TC = Maximum surface temperature in degrees Celsius
P.P. 492 = "Thermal Springs of the United States and Other Countries of the World – A Summary," U.S.G.S. Professional Paper 492 (Waring, 1965)
Circ. 790 = "Assessment of geothermal resources of the United States," U.S.G.S. Circular 790 (Muffler, 1979)
NOAA = 1:250,000-scale overlays in "Thermal Springs List for the United States," NOAA KGRD 12 (Berry, Grim, Ikelman, 1980)
AMS = 1:250,000 AMS Maps
USGS quadrangle = The USGS 15-minute or 7.5-minute quadrangle on which spring may be found

State	Latitude	Longitude	"Popular" or USGS Spring Name	TF	TC	P.P. 492	Circ. 790	NOAA	AMS	USGS Quadrangle
AK	53.8920	-166.930	MAKUSHIN VOLCANO FUMAROLES	310	154	45	null	1	UNALASKA	null
AK	51.9250	-177.160	FUMAROLES ON KANAGA ISLAND	219	104	32	null	1	ADAK	null
AK	53.2130	-168.463	HOT SPRINGS NEAR GEYSER BIGHT	216	102	41	18	7	UMNAK	null
AK	53.2230	-168.477	HOT SPRINGS NEAR GEYSER BIGHT	214	101	41	18	6	UMNAK	null
AK	53.4430	-168.092	THERMAL SPRINGS IN OKMOK CALDERA	212	100	null	null	2	UMNAK	null
AK	52.0420	-176.108	HOT SPRINGS ON GREAT SITKIN ISLAND	210	99	34	16	1	ADAK	null
AK	55.9830	-131.661	BAILEY HOT SPRING	198	92	76	27	1	KETCHIKAN	KETCHIKAN (D-5) 15
AK	53.2420	-168.365	HOT SPRINGS NEAR HOT SPRINGS COVE	192	89	43	17	4	UMNAK	null
AK	54.1570	-165.850	HOT SPRINGS NEAR HOT SPRINGS BAY	181	83	46	20	3	UNIMAK	null
AK	58.0330	-136.017	HOT SPRINGS NORTH END TENAKEE INLET	180	82	null	22	1	MT. FAIRWEATHE R	(MT. FAIRWEATHER (A-1) 15)
AK	65.0930	-164.922	PILGRIM SPRINGS	178	81	6	3	2	BENDELEBEN	BENDELEBEN (A-6) 15
AK	57.8310	-156.513	W UKINEK SPRING	178	81	null	null	2	UGASHIK	(UGASHIK (D-2) 15)
AK	65.4590	-153.312	LITTLE MELOZITNA HOT SPRINGS	176	80	11	9	1	MELOZITNA	MELOZITNA (B-1) 15
AK	65.8580	-164.710	SERPENTINE HOT SPRINGS	171	77	4	2	1	BENDELEBEN	BENDELEBEN (D-6) 15
AK	52.1900	-174.250	HOT SPRINGS ON ATKA ISLAND	167	75	37	null	3	ATKA	null
AK	55.9330	-131.559	BELL ISLAND HOT SPRINGS	165	74	79	28	2	KETCHIKAN	KETCHIKAN (D-5) 15

State	Latitude	Longitude	"Popular" or USGS Spring Name	TF	TC	P.P. 492	Circ. 790	NOAA	AMS	USGS Quadrangle
AK	55.8630	-160.493	HOT SPRING NEAR PORT MOLLER	160	71	54	null	1	PORT MOLLER	PORT MOLLER (D-2) 15
AK	53.2530	-168.358	HOT SPRINGS NEAR HOT SPRINGS COVE	158	70	43	17	3	UMNAK	null
AK	51.9700	-176.610	HOT SPRINGS ON ADAK ISLAND	154	68	33	null	1	ADAK	null
AK	65.0530	-146.057	CHENA HOT SPRINGS	153	67	18	14	1	CIRCLE	CIRCLE (A-5) 15
AK	56.8360	-135.374	GODDARD HOT SPRINGS	153	67	70	25	1	PORT ALEXANDER	PORT ALEXANDER (D-5) 15
AK	58.3700	-137.090	HOT SPRINGS NEAR ICY POINT	153	67	null	null	1	MT. FAIRWEATHE R	(MT. FAIRWEATHER (B-4) 15)
AK	66.3420	-150.850	KANUTI HOT SPRINGS	151	66	null	11	1	BETTLES	(BETTLES (B-2) 15)
AK	64.8500	-162.300	CLEAR CREEK HOT SPRINGS	149	65	null	5	1	SOLOMON	(SOLOMON (D-1) 15)
AK	53.2330	-168.300	HOT SPRING ON UMNAK ISLAND	149	65	42	19	5	UMNAK	null
AK	54.9440	-163.251	HOT SPRINGS NEAR MORZHOVOI	145	63	50	null	1	FALSE PASS	null
AK	61.2000	-159.863	HOT SPRINGS NEAR OPHIR CREEK	145	63	26	null	1	RUSSIAN MISSION	(RUSSIAN MISSION (A-2) 15)
AK	51.7620	-178.770	FUMAROLES ON GARELOI ISLAND	144	62	null	null	2	GARELOI ISLAND	null
AK	65.9830	-150.560	HOT SPRINGS ON LOWER RAY RIVER	142	61	null	null	1	TANANA	(TANANA (D-2) 15)
AK	66.3670	-156.767	HOT SPRINGS NEAR DIVISION BM	140	60	3	null	1	SHUNGNAK	null
AK	65.2740	-148.847	TOLOVANA HOT SPRINGS	140	60	17	12	1	LIVENGOOD	LIVENGOOD (B-4) 15
AK	57.1780	-157.015	HOT SPRING NEAR MOTHER GOOSE LAKE	138	59	null	null	1	UGASHIK	(UGASHIK (A-4) 15)
AK	56.2330	-131.267	BRADFIELD CANAL HOT SPRINGS	135	57	null	null	2	BRADFIELD CANAL	(BRADFIELD CANAL (A-4) 15)
AK	65.4830	-144.637	CIRCLE HOT SPRINGS	135	57	19	15	1	CIRCLE	CIRCLE (B-2) 15
AK	65.0060	-150.633	MANLEY HOT SPRINGS	133	56	14	13	4	TANANA	TANANA (A-2)
AK	65.1290	-154.692	MELOZI (MELOZITNA) SPRINGS	131	55	10	8	3	MELOZITNA	MELOZITNA (A-4) 15
AK	66.2170	-149.547	DALL HOT SPRINGS	129	54	null	null	1	BEAVER	(BEAVER (A-6) 15)
AK	55.2170	-162.483	HOT SPRINGS EAST OF COLD BAY	129	54	null	21	2	COLD BAY	null
AK	57.8650	-156.499	GAS ROCKS HOT SPRING	127	53	56	null	1	UGASHIK	(UGASHIK (D-2) 15)
AK	65.2170	-162.900	HOT SPRINGS NEAR LAVA CREEK	127	53	null	4	1	BENDELEBEN	(BENDELEBEN (A-2) 15)
AK	65.2670	-155.280	HOT SPRINGS NEAR DULBI RIVER	126	52	null	7	1	MELOZITNA	(MELOZITNA (B-5) 15)
AK	57.0850	-134.839	BARANOF WARM SPRINGS	124	51	69	null	1	SITKA	SITKA (A-3) 15
AK	56.7170	-132.005	CHIEF SHAKES HOT SPRINGS	122	50	73	26	1	PETERSBURG	(PETERSBURG (C-1) 15)

State	Latitude	Longitude	"Popular" or USGS Spring Name	TF	TC	P.P. 492	Circ. 790	NOAA	AMS	USGS Quadrangle
AK	66.1500	-157.117	HOT SPRINGS NEAR SOUTH BM	122	50	null	6	3	SHUNGNAK	null
AK	66.2330	-157.583	HOT SPRINGS ON HAWK RIVER	122	50	null	null	2	SHUNGNAK	null
AK	65.8100	-151.237	KILO HOT SPRING	122	50	null	null	1	TANANA	TANANA (D-3)
AK	67.2830	-155.067	REED RIVER HOT SPRING	122	50	1	10	1	SURVEY PASS	null
AK	52.8400	-169.900	CHUGINADAK HOT SPRINGS	H	H	39	null	2	SAMALGA ISLAND	null
AK	65.9080	-154.993	DENIKTOW RIDGE HOT SPRINGS	H	H	null	null	2	MELOZITNA	MELOZITNA (D-4) 15
AK	55.3680	-161.961	FUMAROLE	H	H	52	null	1	PORT MOLLER	null
AK	51.7750	-178.793	FUMAROLES ON GARELOI ISLAND	H	H	null	null	1	GARELOI ISLAND	null
AK	51.9670	178.444	FUMAROLES ON LITTLE SITKIN ISLAND	H	H	null	null	1	RAT ISLANDS	null
AK	51.9440	178.547	FUMAROLES ON LITTLE SITKIN ISLAND	H	H	null	null	3	RAT ISLANDS	null
AK	51.9630	178.491	FUMAROLES ON LITTLE SITKIN ISLAND	H	H	null	null	2	RAT ISLANDS	null
AK	61.2670	-151.238	HOT LAKE IN BOTTOM OF CRATER PEAK	H	H	null	null	1	TYONEK	(TYONEK (B-6) 15)
AK	58.2400	-155.090	HOT SPRING NEAR KATMAI PASS	H	H	57	null	1	MT. KATMAI	(MT. KATMAI (A-4) 15)
AK	65.4500	-150.000	HOT SPRING NEAR LITTLE MINOOK CR	H	H	16	null	3	TANANA	(TANANA (B-1) 15)
AK	61.0580	-160.692	HOT SPRING NEAR TULUKSAK RIVER	H	H	25	null	1	RUSSIAN MISSION	(RUSSIAN MISSION (A-5) 15)
AK	54.9000	-162.885	HOT SPRING ON AMAGAT ISLAND	H	H	51	null	1	FALSE PASS	(FALSE PASS (D-3) 15)
AK	52.9600	-169.710	HOT SPRING ON KAGAMIL ISLAND	H	H	40	null	1	SAMALGA ISLAND	null
AK	51.9400	178.500	HOT SPRING ON LITTLE SITKIN ISLAND	H	H	29	null	4	RAT ISLANDS	null
AK	52.3580	-172.317	HOT SPRING ON SEGUAM ISLAND	H	H	38	null	1	SEGUAM	null
AK	51.8100	-177.790	HOT SPRING ON TANAGA ISLAND	H	H	31	null	2	ADAK	null
AK	64.0020	-156.300	HOT SPRING ON TRIBUTARY OF INNOKO R	H	H	13	null	1	NULATO	(NULATO (A-1) 15)
AK	54.6600	-164.550	HOT SPRING ON UNIMAK ISLAND	H	H	49	null	1	UNIMAK	null
AK	58.9200	-153.980	HOT SPRING WEST OF CAPE DOUGLAS	H	H	59	null	1	AFOGNAK	(AFOGNAK (D-6) 15)
AK	53.2070	-168.445	HOT SPRINGS NEAR GEYSER BIGHT	H	H	41	18	8	UMNAK	null
AK	53.8510	-166.918	HOT SPRINGS NEAR MAKUSHIN VOLCANO	H	H	45	null	3	UNALASKA	null

State	Latitude	Longitude	"Popular" or USGS Spring Name	TF	TC	P.P. 492	Circ. 790	NOAA	AMS	USGS Quadrangle
AK	58.2700	-154.890	HOT SPRINGS NEAR MT KATMAI	H	H	58	null	1	MT. KATMAI	(MT. KATMAI (B-3) 15)
AK	53.8770	-166.448	HOT SPRINGS NEAR SUMMER BAY	H	H	null	null	2	UNALASKA	null
AK	54.2300	-165.660	HOT SPRINGS ON AKUN ISLAND	H	H	null	null	1	UNIMAK	null
AK	54.1800	-165.410	HOT SPRINGS ON AKUN ISLAND	H	H	null	null	2	UNIMAK	null
AK	52.3400	-174.260	HOT SPRINGS ON ATKA ISLAND	H	H	35	null	1	ATKA	null
AK	52.2700	-174.042	HOT SPRINGS ON ATKA ISLAND	H	H	36	null	2	ATKA	null
AK	65.2330	-144.483	HOT SPRINGS ON BIG WINDY CREEK	H	H	20	null	2	CIRCLE	(CIRCLE (A-1) 15)
AK	53.9500	-168.037	HOT SPRINGS ON BOGOSLOF ISLAND	H	H	44	null	1	UMNAK	null
AK	61.3630	-157.733	HOT SPRINGS ON UPPER CHUILNUK RIVER	H	H	null	null	1	SLEETMUTE	(SLEETMUTE (B-4) 15)
AK	65.9700	-154.033	POCAHONTAS HOT SPRINGS	H	H	null	null	1	MELOZITNA	MELOZITNA (D-3) 15

State	Latitude	Longitude	"Popular" or USGS Spring Name	TF	TC	P.P. 492	Circ. 790	NOAA	AMS	USGS Quadrangle
AZ	32.9710	-109.350	GILLARD HOT SPRINGS	180	82	null	32	2	SILVER CITY	GUTHRIE 15
AZ	32.7410	-114.068	RADIUM HOT SPRINGS	140	60	null	null	1	EL CENTRO	WELLTON MESA 7.5
AZ	33.0800	-109.303	HOT SPRING	138	59	null	31	2	CLIFTON	CLIFTON 15
AZ	33.4000	-109.152	HANNAH HOT SPRING	133	56	null	null	1	CLIFTON	DUTCH BLUE CREEK 7.5
AZ	32.3360	-110.240	HOOKERS HOT SPRINGS	127	53	19	null	4	TUCSON	WINCHESTER MTS. 15
AZ	35.9840	-114.742	HOT SPRING	H	H	null	null	1	KINGMAN	RINGBOLT RAPIDS 7.5

State	Latitude	Longitude	"Popular" or USGS Spring Name	TF	TC	P.P. 492	Circ. 790	NOAA	AMS	
CA	38.8020	-122.810	THE GEYSERS	214	101	72	48	21	SANTA ROSA	THE GEYSERS 7.5
CA	38.7670	-122.748	LITTLE GEYSERS	210	99	74	48	27	SANTA ROSA	(WHISPERING PINES 7.5)
CA	41.5340	-120.078	HOT SPRINGS (SURPRISE VALLEY)	208	98	18	35	8	ALTURAS	CEDARVILLE 15
CA	36.0450	-117.769	COSO HOT SPRINGS	207	97	142	57	8	DEATH VALLEY	HAIWEE RESERVOIR 15
CA	36.0360	-117.802	DEVILS KITCHEN	207	97	141	57	9	DEATH VALLEY	HAIWEE RESERVOIR 15
CA	41.6700	-120.206	LAKE CITY HOT SPRINGS	207	97	14	35	4	ALTURAS	CEDARVILLE 15
CA	40.3640	-120.243	HOT SPRING	204	96	null	42	3	SUSANVILLE	WENDEL 15
CA	40.3820	-121.513	MORGAN HOT SPRING	205	96	33	41	10	SUSANVILLE	LASSEN PEAK 15
CA	40.4210	-121.375	TERMINAL GEYSER	205	96	38	40	8	SUSANVILLE	MT. HARKNESS 15
CA	40.3550	-120.257	WENDEL HOT SPRINGS	205	96	30	42	4	SUSANVILLE	LITCHFIELD 15
CA	40.3020	-120.195	AMEDEE HOT SPRINGS	203	95	31	42	5	SUSANVILLE	WENDEL 15
CA	40.4400	-121.434	DEVILS KITCHEN	203	95	34	40	5	SUSANVILLE	MT. HARKNESS 15
CA	36.0310	-117.833	FUMAROLE	203	95	141	57	10	DEATH VALLEY	HAIWEE RESERVOIR 15
CA	40.3930	-121.507	GROWLER HOT SPRING	203	95	null	41	9	SUSANVILLE	LASSEN PEAK 15
CA	40.4550	-121.501	BUMPASS HELL	199	93	27	40	2	SUSANVILLE	LASSEN PEAK 15
CA	37.6480	-118.914	CASA DIABLO HOT SPRINGS AND GEYSER	199	93	123	56	13	MARIPOSA	MT. MORRISON 15
CA	37.6650	-118.828	HOT CREEK GORGE SPRINGS	199	93	null	56	8	MARIPOSA	MT. MORRISON 15
CA	40.4470	-121.536	SULPHUR WORKS, TOPHET HOT SPRINGS	199	93	26	40	3	SUSANVILLE	LASSEN PEAK 15
CA	41.4500	-120.834	KELLY HOT SPRING	198	92	8	38	12	ALTURAS	CANBY 15
CA	34.1850	-117.262	ARROWHEAD SPRINGS, WATERMAN HOT SPR	194	90	162	62	3	SAN BERNARDINO	SAN BERNARDINO NORTH 7.5
CA	34.5960	-118.998	SESPE HOT SPRINGS	194	90	111	61	2	LOS ANGELES	DEVILS HEART PEAK 7.5
CA	40.4340	-121.399	BOILING SPRINGS LAKE	190	88	37	40	7	SUSANVILLE	MT. HARKNESS 15
CA	41.6070	-121.523	HOT SPOT	191	88	3	null	1	ALTURAS	MEDICINE LAKE 15
CA	41.6150	-120.102	SEYFERTH HOT SPRINGS	185	85	16	35	5	ALTURAS	CEDARVILLE 15
CA	41.4070	-122.197	HOT SPRING, FUMAROLES	183	84	3	null	3	WEED	SHASTA 15
CA	37.9930	-119.028	PAOHA ISLAND SPRINGS	181	83	120	null	1	MARIPOSA	(MONO CRATERS 15)
CA	41.0250	-121.924	BIG BEND HOT SPRINGS	180	82	24	39	6	ALTURAS	BIG BEND 15
CA	38.3480	-119.400	FALES HOT SPRINGS	180	82	114	52	4	WALKER LAKE	FALES HOT SPRINGS 7.5
CA	37.6920	-118.839	LITTLE HOT CREEK SPRING	180	82	122	56	5	MARIPOSA	MT. MORRISON 15
CA	38.2450	-119.205	TRAVERTINE HOT SPRINGS	180	82	116	54	5	WALKER LAKE	BODIE 15
CA	41.1430	-121.110	BASSETT HOT SPRINGS	174	79	28	37	3	ALTURAS	BIEBER 15
CA	38.5800	-122.575	CALISTOGA HOT SPRINGS	172	78	81	50	30	SANTA ROSA	CALISTOGA 7.5
CA	41.1260	-121.028	KELLOG HOT SPRINGS	172	78	29	null	4	ALTURAS	BIEBER 15
CA	37.6560	-118.834	HOT CREEK SPRINGS	171	77	null	56	11	MARIPOSA	(MT. MORRISON 15)

State	Latitude	Longitude	"Popular" or USGS Spring Name	TF	TC	P.P. 492	Circ. 790	NOAA	AMS	
CA	41.1900	-120.383	WEST VALLEY RESERVOIR HOT SPRING	171	77	null	36	19	ALTURAS	(TULE MOUNTAIN 7.5)
CA	41.2290	-121.405	LITTLE HOT SPRING	169	76	11	null	2	ALTURAS	FALL RIVER MILLS 15
CA	37.6640	-118.802	THE TUB	167	75	null	56	9	MARIPOSA	(MT. MORRISON 15)
CA	37.6470	-118.859	CASA DIABLO HOT POOL	165	74	124	56	15	MARIPOSA	MT. MORRISON 15
CA	38.7680	-122.717	CASTLE ROCK SPRINGS	163	73	62	48	26	SANTA ROSA	WHISPERING PINES 7.5
CA	39.0570	-122.475	ELGIN MINE	156	69	69	null	9	UKIAH	WILBUR SPRINGS 15
CA	41.9730	-122.202	KLAMATH HOT SPRING	156	69	2	null	1	WEED	MACDOEL 15
CA	39.0020	-122.664	SULPHUR BANK	156	69	57	46	17	UKIAH	CLEARLAKE OAKS 7.5
CA	39.0390	-122.421	WILBUR SPRINGS	153	67	68	44	11	UKIAH	WILBUR SPRINGS 15
CA	40.4440	-121.409	DRAKESBAD	151	66	36	40	4	SUSANVILLE	MT. HARKNESS 15
CA	38.0480	-119.081	HOT SPRING	151	66	null	null	9	WALKER LAKE	BODIE 15
CA	40.4570	-121.545	MILL CREEK SPRINGS	150	66	25	40	1	SUSANVILLE	(LASSEN PEAK 15)
CA	38.7730	-119.713	null	149	65	null	null	1	WALKER LAKE	(MT. SIEGEL 15)
CA	38.6990	-119.846	GROVERS HOT SPRINGS	147	64	113	51	2	WALKER LAKE	MARKLEEVILLE 15
CA	39.1830	-122.700	BARTLETT SPRINGS	144	62	null	null	7	UKIAH	CLEARLAKE OAKS 15
CA	41.6000	-120.088	LEONARDS HOT SPRINGS	144	62	17	35	6	ALTURAS	CEDARVILLE 15
CA	36.2340	-121.546	TASSAJARA HOT SPRINGS	144	62	91	null	6	SANTA CRUZ	TASSAJARA HOT SPRINGS 7.5
CA	39.0330	-122.445	JONES FOUNTAIN OF LIFE SPRING	142	61	null	null	12	UKIAH	WILBUR SPRINGS 15
CA	38.2370	-119.326	BUCKEYE HOT SPRING	140	60	115	53	6	WALKER LAKE	MATTERHORN PEAK 15
CA	33.2840	-116.631	WARNER HOT SPRING	138	59	179	null	7	SANTA ANA	WARNER SPRINGS 7.5
CA	41.0360	-121.926	HUNT HOT SPRING	136	58	23	null	5	ALTURAS	BIG BEND 15
CA	37.8020	-118.532	BENTON HOT SPRINGS	134	57	127	null	2	MARIPOSA	GLASS MOUNTAIN 15
CA	37.6770	-118.790	DEHY HOT SPRING	134	57	null	56	6	MARIPOSA	(MT. MORRISON 15)
CA	41.2660	-120.080	HOT SPRINGS (MENLO BATHS)	135	57	20	null	14	ALTURAS	EAGLEVILLE 7.5
CA	34.5380	-119.560	AGUA CALIENTE SPRING	133	56	null	null	2	LOS ANGELES	HILDRETH PEAK 7.5
CA	33.5580	-117.154	MURRIETTA HOT SPRINGS	132	56	170	null	8	SANTA ANA	MURRIETTA 7.5
CA	35.6200	-118.473	SCOVERN HOT SPRINGS	133	56	149	60	3	BAKERSFIELD	LAKE ISABELLA SOUTH
CA	38.6910	-123.024	SKAGGS SPRINGS	135	56	71	49	3	SANTA ROSA	SKAGGS SPRINGS 7.5
CA	39.2260	-120.010	BROCKWAY HOT SPRINGS	131	55	44	null	5	CHICO	(KINGS BEACH 7.5)
CA	33.7530	-117.495	GLEN IVY HOT SPRINGS	131	55	167	null	4	SANTA ANA	LAKE MATTHEWS 7.5
CA	37.6480	-118.806	HOT SPRINGS	129	54	125	56	14	MARIPOSA	MT. MORRISON 15
CA	37.6670	-118.781	null	127	53	null	56	7	MARIPOSA	(MT. MORRISON 15)
CA	38.8730	-122.689	SEIGLER SPRINGS	126	52	59	47	14	SANTA ROSA	WHISPERING PINES 7.5
CA	33.6700	-117.325	WRENDEN HOT SPRS, ELSINORE HOT SPRS	125	52	168	null	5	SANTA ANA	(ELSINORE 7.5)
CA	36.2290	-118.302	JORDAN HOT SPRINGS	124	51	null	null	2	FRESNO	HOCKETT PEAK 15
CA	37.2530	-118.373	KEOUGH HOT SPRINGS	124	51	138	null	22	MARIPOSA	BISHOP 15
CA	34.4980	-119.341	STINGLEYS HOT SPRINGS	123	51	107	null	8	LOS ANGELES	MATILIJA 7.5

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CA	34.5020	-119.346	VICKERS HOT SPRINGS	124	51	106	null	7	LOS ANGELES	(WHEELER SPRINGS 7.5)
CA	35.8810	-118.670	CALIFORNIA HOT SPRINGS	122	50	137	null	1	BAKERSFIELD	CALIFORNIA HOT SPRINGS 15
CA	36.1230	-121.640	SLATES HOT SPRINGS	122	50	93	null	7	SANTA CRUZ	LOPEZ POINT 7.5
CA	38.9790	-122.659	FUMAROLE	H	H	null	null	4	SANTA ROSA	(CLEARLAKE HIGHLANDS 7.5)
CA	37.6220	-119.028	FUMAROLES	H	H	null	null	5	MARIPOSA	(DEVILS POSTPILE 15)
CA	41.0120	-121.274	HOT SPRINGS	H	H	null	null	7	ALTURAS	FALL RIVER MILLS 15
CA	39.9220	-120.024	ZAMBONI HOT SPRINGS	H	H	null	null	2	CHICO	CONSTANTIA 7.5

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CO	38.7320	-106.178	HORTENSE HOT SPRING	181	83	null	74	5	MONTROSE	PONCHA SPRINGS 15
CO	38.5140	-106.508	UPPER WAUNITA HOT SPRINGS	176	80	14	76	9	MONTROSE	PITKIN 7.5
CO	38.5170	-106.515	LOWER WAUNITA HOT SPRINGS	167	75	null	76	8	MONTROSE	(PITKIN 7.5)
CO	38.4980	-106.076	PONCHA HOT SPRINGS	160	71	21	75	10	MONTROSE	BONANZA 15
CO	38.0210	-107.672	OURAY HOT SPRINGS	156	69	28	null	3	MONTROSE	(OURAY 7.5)
CO	40.5590	-106.849	ROUTT HOT SPRINGS	147	64	2	72	1	CRAIG	ROCKY PEAK 7.5
CO	38.1680	-105.924	MINERAL HOT SPRINGS	140	60	23	null	5	PUEBLO	VILLA GROVE 7.5
CO	38.8120	-106.226	COTTONWOOD HOT SPRINGS	136	58	19	null	3	MONTROSE	BUENA VISTA 15
CO	37.2630	-107.011	PAGOSA SPRINGS	136	58	39	null	7	DURANGO	PAGOSA SPRINGS 7.5
CO	37.7470	-106.831	WAGON WHEEL GAP HOT SPRINGS	135	57	31	79	2	DURANGO	SPAR CITY 15
CO	38.7330	-106.162	MOUNT PRINCETON HOT SPRINGS	133	56	20	74	4	MONTROSE	PONCHA SPRINGS 15
CO	39.2270	-107.224	PENNY HOT SPRINGS	133	56	null	73	4	LEADVILLE	REDSTONE 7.5
CO	39.0170	-105.793	HARTSEL HOT SPRINGS	126	52	17	null	3	DENVER	HARTSEL 7.5
CO	38.1330	-107.736	ORVIS HOT SPRING	126	52	27	null	2	MONTROSE	DALLAS 7.5
CO	39.5480	-107.322	GLENWOOD SPRINGS	124	51	6	null	3	LEADVILLE	GLENWOOD SPRINGS 7.5

State	Latitude	Longitude	"Popular" or USGS Spring Name	TF	TC	P.P. 492	Circ. 790	NOAA	AMS		
ID	42.1070	-113.390	BLM WELL (FRAZIER HOT SPRING)	203	95	184	115	7	POCATELLO	CHOKECHERRY CANYON 7.5	1.
ID	45.3070	-114.338	BIG CREEK HOT SPRINGS	199	93	52	null	4	ELK CITY	SHOUP 15	2.
ID	44.3060	-116.745	CRANE CREEK HOT SPRINGS	198	92	null	null	12	BAKER	(CRANE CREEK RESERVOIR 15)	3.
ID	44.7990	-115.129	INDIAN CREEK HOT SPRING	190	88	null	null	6	CHALLIS	(BIG BALDY 7.5)	4.
ID	44.5680	-115.695	VULCAN HOT SPRINGS	190	88	32	null	20	CHALLIS	WARM LAKE 15	5.
ID	44.3640	-115.856	BOILING SPRINGS	185	85	38	null	29	CHALLIS	BOILING SPRINGS 15	6.
ID	44.1570	-115.314	BONNEVILLE HOT SPRINGS	185	85	80	96	34	CHALLIS	EIGHTMILE MTN. 7.5	7.
ID	42.1330	-111.928	BATTLE CREEK HOT SPRINGS	183	84	null	120	12	PRESTON	BANIDA 7.5	8.
ID	43.5630	-114.798	WORSWICK HOT SPRINGS	180	82	136	110	12	HAILEY	SYDNEY BUTTE 7.5	9.
ID	44.0920	-116.052	DEER HOT SPRINGS	176	80	null	97	14	BAKER	BANKS 15	10.
ID	42.3080	-111.707	MAPLE GROVE HOT SPRINGS	172	78	null	118	11	PRESTON	ONEIDA NARROWS RESERVOIR 7.	11.
ID	43.7550	-115.571	NINEMEYER HOT SPRINGS	169	76	116	98	11	HAILEY	BARBER FLAT 7.5	12.
ID	44.2680	-114.748	SUNBEAM HOT SPRINGS	169	76	93	107	14	CHALLIS	SUNBEAM 7.5	13.
ID	43.2930	-114.908	BARRONS HOT SPRING	167	75	139	112	18	HAILEY	(FAIRFIELD 15)	14.
ID	44.1540	-115.993	WARM SPRINGS CREEK HOT SPRINGS	167	75	73	null	35	CHALLIS	GARDEN VALLEY 15	15.
ID	43.3280	-114.399	MAGIC HOT SPRINGS	163	73	null	109	17	HAILEY	BELLEVUE 15	16.
ID	42.1190	-111.928	SQUAW HOT SPRINGS	163	73	null	121	13	PRESTON	WESTON 7.5	17.
ID	44.8130	-115.123	MIDDLE FORK INDIAN CREEK HOT SPRING	162	72	48	null	5	CHALLIS	PUNGO MOUNTAIN 7.5	18.
ID	44.4160	-116.031	CABARTON HOT SPRING	160	71	null	null	11	BAKER	(SMITHS FERRY 15)	19.
ID	42.3330	-115.650	INDIAN HOT SPRINGS	160	71	169	null	6	TWIN FALLS	null	20.
ID	43.6840	-114.410	GUYER HOT SPRINGS	158	70	142	null	7	HAILEY	GRIFFIN BUTTE 7.5	21.
ID	43.1550	-115.518	HOT SPRINGS	158	70	131	null	26	HAILEY	MOUNTAIN HOME 15	22.
ID	44.5860	-116.630	LAKEY HOT SPRING	158	70	null	null	6	BAKER	(CAMBRIDGE 15)	23.
ID	44.8310	-115.215	KWISKWIS HOT SPRING	156	69	null	null	4	CHALLIS	BIG BALDY 7.5	24.
ID	44.6690	-116.305	COUNCIL MTN HOT SPRINGS	154	68	18	null	4	BAKER	COUNCIL 15	25.
ID	43.7380	-115.583	VAUGHN HOT SPRING	154	68	115	null	12	HAILEY	SHEEP CREEK 7.5	26.
ID	44.1600	-115.177	SACAJAWEA HOT SPRINGS	153	67	81	null	32	CHALLIS	GRANDJEAN 7.5	27.
ID	42.7040	-114.856	SALMON FALLS HOT SPRING	153	67	173	null	1	TWIN FALLS	(THOUSAND SPRINGS 7.5)	28.
ID	42.3330	-111.716	CLEVELAND HOT SPRINGS	151	66	null	null	10	PRESTON	ONEIDA NARROWS RESERVOIR 7.	29.
ID	43.9510	-116.353	ROYSTONE HOT SPRINGS	151	66	66	95	2	BOISE	MONTOUR 15	30.
ID	43.6710	-115.696	TWIN SPRINGS	151	66	84	null	17	HAILEY	TWIN SPRINGS 7.5	31.
ID	43.7890	-115.434	DUTCH FRANK HOT SPRING	149	65	119	null	7	HAILEY	GRAND MTN. 7.5	32.
ID	44.0720	-115.543	KIRKHAM HOT SPRINGS	149	65	79	null	37	CHALLIS	LOWMAN 7.5	33.
ID	44.7300	-114.993	SUNFLOWER HOT SPRINGS	149	65	null	null	6	CHALLIS	SLIDEROCK RIDGE 7.5	34.
ID	44.0770	-115.553	HAVEN LODGE HOT SPRING	147	64	78	null	36	CHALLIS	(LOWMAN 7.5)	35.

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ID	43.3830	-114.931	WARDROP HOT SPRING	147	64	137	111	16	HAILEY	FAIRFIELD 15	36.
ID	44.6450	-114.739	UPPER LOON CREEK HOT SPRINGS	145	63	56	null	10	CHALLIS	ROCK CREEK 7.5	37.
ID	43.0490	-114.952	WHITE ARROW HOT SPRING	145	63	170	113	20	HAILEY	DAVIS MOUNTAIN 15	38.
ID	43.1160	-115.305	LATTY HOT SPRING	144	62	131	99	28	HAILEY	BENNETT MTN. 15	39.
ID	43.7880	-115.444	STRAIGHT CREEK HOT SPRING	144	62	118	null	8	HAILEY	(GRAND MTN. 7.5)	40.
ID	45.0390	-116.291	ZIMS RESORT HOT SPRINGS	144	62	16	null	5	GRANGEVILLE	BALLY MOUNTAIN 7.5	41.
ID	43.6960	-115.658	SHEEP CREEK BRIDGE HOT SPRING	142	61	110	null	16	HAILEY	TWIN SPRINGS 7.5	42.
ID	44.9140	-115.722	TEAPOT HOT SPRING	142	61	25	null	1	CHALLIS	TEAPOT MTN. 7.5	43.
ID	43.8110	-115.116	ATLANTA HOT SPRINGS	140	60	123	null	5	HAILEY	ATLANTA EAST 7.5	44.
ID	45.5120	-115.046	BARTH HOT SPRINGS	140	60	11	null	2	ELK CITY	SHEEP HILL 7.5	45.
ID	44.0510	-115.829	DAN HODGES HOT SPRING	140	60	75	null	41	CHALLIS	(GARDEN VALLEY 15)	46.
ID	43.6470	-114.816	SKILLERN HOT SPRINGS	140	60	133	null	8	HAILEY	PARADISE PEAK 7.5	47.
ID	44.6790	-116.231	WHITE LICKS HOT SPRING	140	60	19	null	3	BAKER	CASCADE 15	48.
ID	42.6880	-114.826	BANBURY HOT SPRING	138	59	175	114	3	TWIN FALLS	THOUSAND SPRINGS 7.5	49.
ID	43.5400	-115.288	BRIDGE HOT SPRINGS	138	59	128	null	23	HAILEY	(FEATHERVILLE 7.5)	50.
ID	45.4310	-116.015	COW FLATS HOT SPRING	138	59	12	null	1	GRANGEVILLE	(KELLY MOUNTAIN 7.5)	51.
ID	44.3820	-115.841	DASH CREEK HOT SPRINGS	138	59	37	null	28	CHALLIS	BOILING SPRINGS 15	52.
ID	44.6420	-115.693	MOLLYS HOT SPRING	138	59	33	null	13	CHALLIS	(WARM LAKE 15)	53.
ID	44.0620	-115.685	PINE FLAT HOT SPRINGS	138	59	77	null	38	CHALLIS	PINE FLAT 7.5	54.
ID	43.7200	-115.617	SMITH CABIN HOT SPRING	138	59	112	null	14	HAILEY	SHEEP CREEK 7.5	55.
ID	44.7210	-115.010	THOMAS CREEK RANCH HOT SPRING	138	59	null	null	10	CHALLIS	GREYHOUND RIDGE 15	56.
ID	44.2450	-114.885	ELKHORN HOT SPRING	136	58	90	null	19	CHALLIS	(STANLEY 7.5)	57.
ID	45.0350	-115.561	SHEEP CREEK HOT SPRING	136	58	24	null	6	ELK CITY	(PARKS PEAK 7.5)	58.
ID	43.1290	-115.340	COYOTE HOT SPRING	135	57	null	null	27	HAILEY	(BENNETT MTN. 15)	59.
ID	44.6610	-114.652	FOSTER RANCH HOT SPRINGS	135	57	57	null	8	CHALLIS	ROCK CREEK 7.5	60.
ID	44.2640	-114.818	BASIN CREEK HOT SPRING	133	56	92	null	15	CHALLIS	(EAST BASIN CREEK 7.5)	61.
ID	43.6050	-114.948	LIGHTFOOT HOT SPRINGS	133	56	134	null	10	HAILEY	BOARDMAN CREEK 7.5	62.
ID	44.6520	-114.734	OWEN CABIN HOT SPRING	133	56	56	null	9	CHALLIS	ROCK CREEK 7.5	63.
ID	43.6050	-115.664	RATTLESNAKE HOT SPRING	133	56	null	null	19	HAILEY	(LONG GULCH 7.5)	64.
ID	44.0450	-115.842	CORDER HOT SPRING	131	55	76	null	42	CHALLIS	GARDEN VALLEY 15	65.
ID	44.2110	-116.710	COVE CREEK HOT SPRING	131	55	null	null	13	BAKER	(HOLLAND GULCH 7.5)	66.
ID	44.7850	-114.855	COX HOT SPRINGS	131	55	49	null	5	CHALLIS	RAMEY HILL 7.5	67.
ID	44.0440	-115.851	DONLAY RANCH HOT SPRING	131	55	null	null	43	CHALLIS	(GARDEN VALLEY 15)	68.

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ID	43.8030	-115.401	GRANITE CREEK HOT SPRING	131	55	120	null	6	HAILEY	GRAND MTN. 7.5	69.
ID	43.5060	-114.354	HAILEY HOT SPRINGS	131	55	145	null	14	HAILEY	HAILEY 7.5	70.
ID	42.6920	-114.859	HOT SULPHUR (MIRACLE HOT) SPRINGS	131	55	174	null	2	TWIN FALLS	THOUSAND SPRINGS 7.5	71.
ID	45.7880	-115.198	RED RIVER HOT SPRINGS	131	55	10	null	1	ELK CITY	SABLE HILL 7.5	72.
ID	44.2470	-114.676	ROBINSON BAR HOT SPRINGS	131	55	95	null	18	CHALLIS	ROBINSON BAR 7.5	73.
ID	44.8530	-116.442	STARKEY HOT SPRINGS	131	55	null	null	2	BAKER	NEW MEADOWS 15	74.
ID	43.6370	-115.130	WILLOW CREEK HOT SPRING	131	55	126	null	18	HAILEY	CAYUSE POINT 7.5	75.
ID	43.7240	-115.604	LOFTUS HOT SPRING	129	54	113	null	13	HAILEY	SHEEP CREEK 7.5	76.
ID	43.9740	-114.499	LOWER BOWERY HOT SPRING	129	54	null	null	3	HAILEY	(RYAN PEAK 7.5)	77.
ID	44.6320	-115.697	SOUTH FORK PLUNGE	129	54	31	null	15	CHALLIS	(WARM LAKE 15)	78.
ID	44.6760	-115.943	GOLD FORK HOT SPRING	127	53	28	null	12	CHALLIS	GOLD FORK 15	79.
ID	43.5610	-114.415	CLARENDON HOT SPRINGS	126	52	151	null	13	HAILEY	MAHONEY BUTTE 7.5	80.
ID	43.4230	-114.627	ELK CREEK HOT SPRING	126	52	138	null	15	HAILEY	BLAINE 15	81.
ID	44.5310	-116.754	FAIRCHILD HOT SPRING	126	52	null	null	8	BAKER	STURGILL PEAK 15	82.
ID	42.0320	-115.363	MURPHY HOT SPRINGS	126	52	169	103	7	TWIN FALLS	null	83.
ID	43.5530	-115.267	PARADISE HOT SPRINGS	126	52	129	null	22	HAILEY	FEATHERVILLE 7.5	84.
ID	45.0130	-113.605	SHARKEY HOT SPRING	126	52	60	106	2	DILLON	GOLDSTONE MTN. 15	85.
ID	43.3270	-113.918	CONDIE HOT SPRINGS	124	51	147	null	3	IDAHO FALLS	null	86.
ID	44.0540	-115.907	HOT SPRING CAMPGROUND	124	51	74	null	40	CHALLIS	GARDEN VALLEY 15	87.
ID	44.1450	-112.554	LIDY HOT SPRINGS	124	51	150	null	3	DUBOIS	LIDY HOT SPRINGS 7.5	88.
ID	43.6410	-114.487	WARFIELD HOT SPRING	124	51	143	null	9	HAILEY	GRIFFIN BUTTE 7.5	89.
ID	43.9820	-114.486	WEST PASS HOT SPRING	124	51	103	null	2	HAILEY	RYAN PEAK 7.5	90.
ID	43.7790	-115.486	BROWN CREEK HOT SPRING	122	50	117	null	9	HAILEY	(GRAND MTN. 7.5)	91.
ID	45.3440	-114.463	OWL CREEK HOT SPRINGS	122	50	51	104	3	ELK CITY	SHOUP 15	92.
ID	44.6280	-114.601	SHOWER BATH SPRINGS	122	50	58	null	11	CHALLIS	SHELDON PEAK 7.5	93.
ID	44.1710	-114.624	SLATE CREEK HOT SPRING	122	50	99	108	21	CHALLIS	LIVINGSTON CREEK 7.5	94.
ID	44.6260	-115.749	TRAIL CREEK HOT SPRING	122	50	30	null	17	CHALLIS	(WARM LAKE 15)	95.
ID	43.7180	-115.563	BASSET HOT SPRING	H	H	null	null	15	HAILEY	(SHEEP CREEK 7.5)	96.
ID	43.7010	-114.738	BIG SMOKEY HOT SPRING	H	H	132	null	6	HAILEY	BAKER PEAK 7.5	97.
ID	44.7700	-115.663	BILLY HOT SPRING	H	H	null	null	7	CHALLIS	WHITE ROCK PEAK 7.5	98.
ID	44.4300	-115.762	BULL CREEK HOT SPRINGS	H	H	39	null	24	CHALLIS	BOILING SPRINGS 15	99.
ID	44.5830	-116.112	CASCADE RESERVOIR HOT SPRING	H	H	null	null	7	BAKER	(CASCADE 15)	100.
ID	44.8960	-114.563	FORGE CREEK HOT SPRINGS	H	H	null	null	2	CHALLIS	YELLOWJACKET 7.5	101.
ID	44.4000	-115.820	GOAT HOT SPRINGS	H	H	35	null	25	CHALLIS	BOILING SPRINGS 15	102.
ID	44.1600	-115.167	GRANDJEAN HOT SPRING	H	H	null	null	33	CHALLIS	GRANDJEAN 7.5	103.

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ID	43.8170	-115.046	LEGGIT CREEK HOT SPRING	H	H	null	null	3	HAILEY	(ATLANTA EAST 7.5)	104.
ID	46.0060	-115.021	MARTEN HOT SPRINGS	H	H	8	null	4	HAMILTON	MINK PEAK 7.5	105.
ID	43.5880	-115.988	MORES CREEK HOT SPRING	H	H	null	null	21	HAILEY	(ARROWROCK DAM 7.5)	106.
ID	44.9510	-114.704	MORMON RANCH WARM SPRING	H	H	54	null	1	CHALLIS	APAREJO POINT 7.5	107.
ID	42.6370	-114.892	POISON SPRINGS	H	H	176	null	4	TWIN FALLS	BUHL 15	108.
ID	46.2350	-114.707	PROSPECTOR HOT SPRINGS	H	H	7	null	3	HAMILTON	(WAHOO PEAK 7.5)	109.
ID	43.8310	-115.192	QUEENS RIVER HOT SPRING	H	H	null	null	1	HAILEY	ATLANTA WEST 7.5	110.
ID	45.1700	-115.807	SECESH HOT SPRING	H	H	22	null	4	ELK CITY	(LOON LAKE 7.5)	111.
ID	44.6280	-115.197	SHEEPEATER HOT SPRINGS	H	H	null	null	16	CHALLIS	GREYHOUND RIDGE 15	112.
ID	46.1380	-115.090	STUART HOT SPRINGS	H	H	6	null	3	HAMILTON	BIG ROCK MTN. 7.5	113.
ID	44.5850	-115.072	SULPHUR CREEK HOT SPRING	H	H	null	null	19	CHALLIS	(GREYHOUND RIDGE 15)	114.
ID	44.5540	-115.301	SULPHUR CREEK HOT SPRING	H	H	43	null	21	CHALLIS	(CHINOOK MTN. 15)	115.

State	Latitude	Longitude	"Popular" or USGS Spring Name	TF	TC	P.P. 492	Circ. 790	NOAA	AMS	State	Latitude
MT	45.3670	-111.726	ENNIS HOT SPRINGS	181	83	null	129	5	BOZEMAN	(ENNIS 15)	1.
MT	46.1780	-112.794	WARM SPRINGS (STATE HOSPITAL)	172	78	15	null	6	BUTTE	ANACONDA NE 7.5	2.
MT	46.1980	-112.094	BOULDER HOT SPRINGS	169	76	19	125	5	BUTTE	BOULDER 15	3.
MT	45.6850	-112.295	SILVER STAR HOT SPRINGS	163	73	30	128	3	DILLON	(TWIN BRIDGES 15)	4.
MT	46.0440	-112.811	GREGSON HOT SPRINGS	158	70	17	126	8	BUTTE	ANACONDA 15	5.
MT	45.0900	-110.774	LADUKE (CORWIN) HOT SPRING	154	68	38	null	6	BOZEMAN	MINER 15	6.
MT	44.9840	-111.613	WOLF CREEK HOT SPRINGS	154	68	null	null	1	ASHTON	CLIFF LAKE 15	7.
MT	46.5960	-112.108	BROADWATER (HELENA) HOT SPRINGS	151	66	7	123	3	BUTTE	(HELENA 15)	8.
MT	45.7570	-110.256	HUNTERS HOT SPRINGS	140	60	36	null	1	BOZEMAN	HUNTERS HOT SPRINGS	9.
MT	45.3680	-113.403	JARDINE HOT SPRING	140	60	25	null	3	DILLON	JACKSON 7.5	10.
MT	46.4480	-111.982	ALHAMBRA HOT SPRINGS	138	59	18	124	1	WHITE SULPHUR	(CLANCY 15)	11.
MT	46.5470	-110.903	WHITE SULPHUR SPRINGS	136	58	24	null	1	WHITE SULPHUR	WHITE SULPHUR SPRINGS 7.5	12.
MT	45.8960	-112.233	PIPESTONE HOT SPRINGS	135	57	20	null	1	DILLON	DRY MOUNTAIN 7.5	13.
MT	45.6600	-111.186	BOZEMAN HOT SPRINGS	131	55	35	null	1	BOZEMAN	BOZEMAN 15	14.
MT	45.4620	-112.475	NEW BILTMORE HOT SPRINGS	127	53	null	null	4	DILLON	BEAVERHEAD ROCK 7.5	15.
MT	45.5750	-111.683	NORRIS HOT SPRINGS	127	53	32	127	4	BOZEMAN	NORRIS 15	16.
MT	45.6020	-111.900	POTOSI WARM SPRINGS	124	51	null	null	2	BOZEMAN	HARRISON 15	17.
MT	45.5900	-111.899	POTOSI HOT SPRINGS	122	50	31	null	3	BOZEMAN	HARRISON 15	18.
MT	45.7920	-112.126	RENOVA HOT SPRINGS	122	50	null	null	2	DILLON	(VENDOME 7.5)	19.
MT	46.1060	-114.004	SLEEPING CHILD HOT SPRINGS	122	50	12	null	2	HAMILTON	DEER MOUNTAIN 7.5	20.

State	Latitude	Longitude	"Popular" or USGS Spring Name	TF	TC	P.P. 492	Circ. 790	NOAA	AMS	State	Latitude
NM	35.9080	-106.615	SULPHUR SPRINGS	189	87	12	171	3	ALBUQUERQUE	VALLE SAN ANTONIO 7.5	1.
NM	35.7720	-106.690	JEMEZ SPRINGS	169	76	15	172	7	ALBUQUERQUE	JEMEZ SPRINGS 7.5	2.
NM	33.1080	-108.483	TURKEY CREEK HOT SPRING	165	74	29	null	15	CLIFTON	(CANYON HILL 7.5)	3.
NM	33.1990	-108.209	GILA HOT SPRINGS	151	66	30	null	12	CLIFTON	GILA HOT SPRINGS 7.5	4.
NM	33.2330	-108.235	SPRING (HOT)	149	65	27	null	10	CLIFTON	GILA HOT SPRINGS 7.5	5.
NM	33.2120	-108.228	null	149	65	null	null	11	CLIFTON	(GILA HOT SPRINGS 7.5)	6.
NM	35.6530	-105.290	MONTEZUMA HOT SPRINGS	138	59	20	null	1	SANTA FE	MONTEZUMA 7.5	7.
NM	32.7480	-107.836	MIMBRES HOT SPRINGS	136	58	34	null	3	LAS CRUCES	DWYER 15	8.
NM	32.5540	-107.994	FAYWOOD HOT SPRINGS	129	54	36	null	6	LAS CRUCES	DWYER 15	9.
NM	35.9380	-106.646	SAN ANTONIO HOT SPRING	129	54	10	null	2	ALBUQUERQUE	SEVEN SPRINGS 7.5	10.
NM	35.6460	-106.888	WARM SPRINGS	129	54	null	null	8	ALBUQUERQUE	HOLY GHOST SPRING 7.5	11.
NM	32.5010	-106.926	RADIUM SPRINGS	127	53	38	175	1	LAS CRUCES	SAN DIEGO MOUNTAIN 15	12.
NM	33.1920	-108.180	LYONS HUNTING LODGE HOT SPRINGS	126	52	31	null	13	CLIFTON	(GILA HOT SPRINGS 7.5)	13.
NM	35.5920	-106.753	INDIAN SPRINGS	123	51	17	null	10	ALBUQUERQUE	(SAN YSIDRO 7.5)	14.
NM	33.2370	-108.880	HOT SPRINGS	H	H	null	null	9	CLIFTON	WILSON MOUNTAIN 7.5	15.

State	Latitude	Longitude	"Popular" or USGS Spring Name	TF	TC	P.P. 492	Circ. 790	NOAA	AMS	State	Latitude
NV	39.5650	-118.856	(SODA LAKE AREA)	210	99	null	144	3	RENO	SODA LAKE 15	1.
NV	40.5670	-116.588	BEOWAWE HOT SPRINGS (THE GEYSERS)	208	98	77	162	9	WINNEMUCCA	DUNPHY 15	2.
NV	39.7870	-119.011	BRADYS HOT SPRINGS	209	98	72	147	4	RENO	FIREBALL RIDGE 15	3.
NV	40.6620	-119.365	GREAT BOILING SPRING (GERLACH)	208	98	38	137	8	LOVELOCK	GERLACH 15	4.
NV	40.1460	-119.673	THE NEEDLE ROCKS HOT SPRING	208	98	49	139	12	LOVELOCK	THE NEEDLE ROCKS 7.5	5.
NV	40.1410	-119.687	THE NEEDLE ROCKS HOT SPRINGS	208	98	49	139	13	LOVELOCK	THE NEEDLE ROCKS 7.5	6.
NV	40.6040	-117.648	LEACH HOT SPRINGS	207	97	64	154	9	WINNEMUCCA	LEACH HOT SPRINGS 15	7.
NV	39.9540	-117.917	FUMAROLES	204	96	70	null	2	MILLETT	(HUMBOLDT SALT MARSH 15)	8.
NV	39.3880	-119.743	STEAMBOAT SPRINGS	205	96	null	141	13	RENO	STEAMBOAT 7.5	9.
NV	39.3800	-119.740	STEAMBOAT SPRINGS	205	96	56	141	14	RENO	STEAMBOAT 7.5	10.
NV	40.5850	-115.285	SULPHUR HOT SPRINGS	205	96	null	169	6	ELKO	LAMOILLE 15	11.
NV	41.0030	-119.008	null	204	96	null	null	26	VYA	null	12.
NV	38.8220	-117.183	DARROUGHS HOT SPRINGS	203	95	118	161	3	TONOPAH	CARVERS 7.5	13.
NV	40.3890	-119.402	HOT SEEPS (SAN EMIDIO DESERT)	203	95	null	138	10	LOVELOCK	(KUMIVA PEAK 15)	14.
NV	39.1610	-119.183	WABUSKA HOT SPRINGS	201	94	62	142	17	RENO	WABUSKA 15	15.
NV	39.4840	-119.804	MOANA SPRINGS	199	93	55	140	8	RENO	MT. ROSE NE 7.5	16.
NV	41.3630	-118.788	PINTO HOT SPRINGS	199	93	null	132	13	VYA	PINTO MOUNTAIN 7.5	17.
NV	39.3160	-117.549	HOT SPRINGS	198	92	85	159	4	MILLETT	CARROLL SUMMIT SE 7.5	18.
NV	41.3570	-118.809	WEST PINTO HOT SPRING	198	92	null	132	14	VYA	PINTO MOUNTAIN 7.5	19.
NV	41.4680	-116.150	HOT SULPHUR SPRINGS (TUSCARORA)	194	90	null	164	1	MCDERMITT	TUSCARORA 15	20.
NV	40.9480	-119.002	null	194	90	null	134	2	LOVELOCK	null	21.
NV	40.6740	-119.364	null	194	90	null	137	7	LOVELOCK	(GERLACH 15)	22.
NV	40.8130	-115.778	ELKO HOT SPRING	190	88	32	166	3	ELKO	ELKO WEST 7.5	23.
NV	39.2080	-118.723	LEE HOT SPRINGS, ALLEN SPRINGS	190	88	74	143	7	RENO	ALLEN SPRINGS 15	24.
NV	40.2620	-119.379	BOILING SPRINGS	187	86	50	null	11	LOVELOCK	KUMIVA PEAK 15	25.
NV	40.7700	-119.113	BUTTE SPRINGS (TREGO HOT SPRINGS)	187	86	63	135	5	LOVELOCK	null	26.
NV	40.3160	-116.433	HOT SPRING	186	86	null	null	13	WINNEMUCCA	FRENCHIE CREEK 15	27.
NV	39.5970	-119.110	PATUA HOT SPRINGS (FERNLEY)	187	86	null	146	6	RENO	(TWO TIPS 15)	28.
NV	40.7610	-117.492	HOT SPRINGS	185	85	19	157	8	WINNEMUCCA	GOLDRUN CREEK 7.5	29.
NV	40.0880	-117.725	SOU (SEVEN DEVILS) HOT SPRINGS	185	85	68	153	19	WINNEMUCCA	CAIN MOUNTAIN 15	30.

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NV	40.6530	-119.378	MUD SPRINGS	184	84	39	137	9	LOVELOCK	(GERLACH 15)	31.
NV	38.7680	-119.174	WILSON HOT SPRING	183	84	null	null	6	WALKER LAKE	YERINGTON 15	32.
NV	41.9210	-118.709	BALTAZOR HOT SPRING	181	83	null	130	3	VYA	DENIO 15	33.
NV	39.3420	-118.578	BORAX SPRING	180	82	74	null	5	RENO	(CARSON LAKE 15)	34.
NV	40.8570	-119.328	FLY RANCH (WARDS) HOT SPRINGS	180	82	37	136	3	LOVELOCK	null	35.
NV	38.5210	-116.365	HOT CREEK RANCH HOT SPRING	180	82	null	null	7	TONOPAH	HOBBLE CANYON 7.5	36.
NV	39.9410	-116.681	HOT SPRINGS	180	82	92	null	3	MILLETT	WALTI HOT SPRINGS 15	37.
NV	39.0280	-117.136	MCLEOD RANCH HOT SPRING	180	82	114	null	6	MILLETT	MILLETT RANCH 15	38.
NV	41.0510	-119.028	DOUBLE HOT SPRINGS	178	81	12	133	21	VYA	null	39.
NV	40.0030	-117.718	HYDER HOT SPRINGS	176	80	69	null	23	WINNEMUCCA	CAIN MOUNTAIN 15	40.
NV	39.6650	-114.807	MONTE NEVA HOT SPRINGS	176	80	98	null	5	ELY	null	41.
NV	40.3680	-117.327	BUFFALO VALLEY HOT SPRINGS	174	79	78	158	13	WINNEMUCCA	BUFFALO SPRINGS 15	42.
NV	40.6990	-116.133	HOT SPRINGS (CARLIN)	174	79	null	165	4	WINNEMUCCA	(CARLIN 15)	43.
NV	41.0130	-119.010	null	172	78	null	null	25	VYA	null	44.
NV	40.4080	-117.883	KYLE HOT SPRINGS	171	77	66	152	12	WINNEMUCCA	KYLE HOT SPRINGS 15	45.
NV	41.0520	-118.717	MACFARLANE HOT SPRING	170	77	null	null	16	VYA	KING LEAR PEAK 15	46.
NV	40.9610	-117.494	GOLCONDA HOT SPRING (NORTH)	165	74	19	155	2	WINNEMUCCA	GOLCONDA 7.5	47.
NV	41.7220	-118.523	null	163	73	null	null	7	VYA	DUFFER PEAK 15	48.
NV	40.4180	-117.415	BUFFALO SPRINGS	162	72	null	null	11	WINNEMUCCA	BUFFALO SPRINGS 15	49.
NV	39.7970	-118.067	DIXIE HOT SPRINGS	162	72	71	149	2	RENO	DIXIE HOT SPRINGS 15	50.
NV	39.3280	-116.858	SPENCER HOT SPRINGS	162	72	86	160	10	MILLETT	SPENCER HOT SPRINGS	51.
NV	39.9040	-116.588	WALTI HOT SPRINGS	162	72	93	null	4	MILLETT	WALTI HOT SPRINGS 15	52.
NV	41.0220	-119.015	null	161	72	null	null	24	VYA	null	53.
NV	40.5780	-117.219	null	162	72	null	null	10	WINNEMUCCA	(ANTLER PEAK 15)	54.
NV	38.4640	-115.792	CHIMNEY WARM SPRING	160	71	127	null	11	LUND	THE WALL NE 7.5	55.
NV	38.9810	-119.833	WALLEYS HOT SPRINGS	160	71	60	null	1	WALKER LAKE	MINDEN 7.5	56.
NV	41.5670	-118.564	DYKE HOT SPRINGS	158	70	10	131	10	VYA	DUFFER PEAK 15	57.
NV	41.1080	-117.578	HOT SPRINGS	158	70	null	null	2	MCDERMITT	(BLISS 15)	58.
NV	39.4040	-116.347	KLOBE (BARTHOLOMAE) HOT SPRING	156	69	93	null	9	MILLETT	ANTELOPE PEAK 15	59.
NV	41.1470	-119.022	null	153	67	null	null	18	VYA	null	60.
NV	40.9540	-117.488	GOLCONDA HOT SPRING (SOUTH)	151	66	19	155	3	WINNEMUCCA	GOLCONDA 7.5	61.
NV	41.5760	-115.181	HOT CREEK SPRINGS	151	66	30	null	4	WELLS	HOT CREEK 15	62.
NV	41.1120	-119.002	null	151	66	null	null	20	VYA	null	63.
NV	40.2200	-116.068	BRUFFEYS HOT SPRINGS	149	65	90	null	15	WINNEMUCCA	MINERAL HILL 15	64.
NV	40.2490	-115.409	SMITH RANCH SPRINGS	149	65	34	null	7	ELKO	RUBY LAKE NW 7.5	65.

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NV	40.7650	-116.040	HOT SULPHUR SPRINGS	147	64	31	null	2	WINNEMUCCA	HUNTSMAN RANCH 7.5	66.
NV	41.8670	-114.692	SAN JACINTO RANCH SPRING	148	64	22	null	5	WELLS	(DELAPLAIN 15)	67.
NV	36.0020	-114.742	SPRING	145	63	null	null	7	LAS VEGAS	(HOOVER DAM 15)	68.
NV	38.1880	-116.373	WARM SPRINGS	145	63	125	null	11	TONOPAH	WARM SPRINGS 7.5	69.
NV	39.8830	-114.893	CHERRY CREEK HOT SPRINGS	144	62	95	170	2	ELY	null	70.
NV	38.8990	-119.410	NEVADA (HINDS) HOT SPRINGS	144	62	61	null	3	WALKER LAKE	WELLINGTON 15	71.
NV	38.9220	-118.198	WEDELL HOT SPRINGS	144	62	113	null	2	WALKER LAKE	null	72.
NV	38.4370	-116.277	HOT CREEK VALLEY SPRING	142	61	124	null	8	TONOPAH	(BLUE JAY SPRING 7.5)	73.
NV	41.1830	-114.991	HOT SPRINGS	142	61	30	null	12	WELLS	OXLEY PEAK 7.5	74.
NV	37.8250	-117.337	ALKALI HOT SPRING	140	60	112	null	3	GOLDFIELD	ALKALI 7.5	75.
NV	41.7880	-114.735	MINERAL HOT SPRING	140	60	22	167	6	WELLS	(DELAPLAIN 15)	76.
NV	40.4170	-116.507	CRESCENT VALLEY HOT SPRINGS	138	59	null	163	10	WINNEMUCCA	CRESCENT VALLEY 15	77.
NV	40.4040	-116.517	CRESCENT VALLEY HOT SPRINGS	138	59	88	163	11	WINNEMUCCA	CRESCENT VALLEY 15	78.
NV	39.0310	-116.666	DIANAS PUNCH BOWL	138	59	null	null	14	MILLETT	DIANAS PUNCH BOWL 15	79.
NV	41.4120	-114.675	WINE CUP RANCH SPRINGS	138	59	null	null	7	WELLS	WINE CUP RANCH 7.5	80.
NV	40.9720	-119.007	BLACK ROCK HOT SPRING	136	58	16	134	1	LOVELOCK	null	81.
NV	40.6030	-116.463	HORSESHOE RANCH SPRINGS	136	58	88	null	7	WINNEMUCCA	(BEOWAWE 15)	82.
NV	40.9220	-117.108	HOT POT (BLOSSOM HOT SPRINGS)	136	58	19	156	4	WINNEMUCCA	HOT POT 7.5	83.
NV	41.3780	-119.182	SPRINGS (HOT)	136	58	null	null	7	VYA	SOLDIER MEADOW 7.5	84.
NV	40.1780	-117.496	HOME STATION RANCH HOT SPRING	135	57	null	null	18	WINNEMUCCA	MT. MOSES 15	85.
NV	41.7210	-118.505	HOWARD HOT SPRING	135	57	null	null	8	VYA	DUFFER PEAK 15	86.
NV	41.4210	-117.388	THE HOT SPRINGS	135	57	11	null	1	MCDERMITT	HOT SPRINGS PEAK 15	87.
NV	39.2860	-119.840	BOWERS MANSION HOT SPRING	133	56	57	null	15	RENO	WASHOE CITY 7.5	88.
NV	40.8190	-115.777	HOT HOLE	133	56	null	166	2	ELKO	ELKO WEST 7.5	89.
NV	41.3570	-119.188	SPRINGS (HOT)	133	56	null	null	9	VYA	MUD MEADOW 7.5	90.
NV	41.9250	-118.805	BOG HOT SPRINGS	131	55	2	null	2	VYA	RAILROAD POINT 15	91.
NV	41.8090	-118.861	PAINTED HILLS MINE	131	55	null	null	4	VYA	(RAILROAD POINT 15)	92.
NV	40.1830	-117.102	HOT SPRINGS RANCH	129	54	81	null	17	WINNEMUCCA	THE CEDARS 15	93.
NV	41.6470	-115.775	WILD HORSE HOT SPRINGS	129	54	null	null	3	WELLS	WILD HORSE 15	94.
NV	41.3830	-119.187	null	130	54	null	null	6	VYA	(SOLDIER MEADOW 7.5)	95.
NV	39.4200	-119.738	DIMONTE SPRING	127	53	55	null	12	RENO	(STEAMBOAT 7.5)	96.
NV	40.1910	-117.107	HOT SPRINGS	127	53	null	null	16	WINNEMUCCA	THE CEDARS 15	97.

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NV	40.1980	-117.103	HOT SPRINGS	127	53	80	null	15	WINNEMUCCA	THE CEDARS 15	98.
NV	41.3530	-119.216	SPRING (HOT)	127	53	null	null	11	VYA	MUD MEADOW 7.5	99.
NV	41.3390	-119.192	SPRINGS (HOT)	127	53	null	null	12	VYA	MUD MEADOW 7.5	100.
NV	38.9520	-115.230	WILLIAMS HOT SPRING	127	53	103	null	1	LUND	null	101.
NV	41.2610	-115.305	HOT SPRINGS	126	52	28	null	5	WELLS	HOT SPRINGS CREEK 7.5	102.
NV	39.0410	-116.663	HOT SPRING	124	51	null	null	13	MILLETT	DIANAS PUNCH BOWL 15	103.
NV	40.6730	-116.838	HOT SPRINGS	122	50	null	null	6	WINNEMUCCA	BATTLE MOUNTAIN 15	104.
NV	39.0580	-119.742	SARATOGA HOT SPRING	122	50	null	null	21	RENO	MC TARNAHAN HILL 7.5	105.
NV	41.3650	-119.221	SPRING (HOT)	122	50	null	null	8	VYA	MUD MEADOW 7.5	106.
NV	41.1590	-114.986	THREEMILE SPRING, SULPHUR HOT SPR	122	50	30	168	13	WELLS	OXLEY PEAK 7.5	107.
NV	39.9950	-117.854	SENATOR FUMAROLES	B	B	null	null	1	MILLETT	(HUMBOLDT SALT MARSH 15)	108.
NV	39.8660	-118.017	DIXIE COMSTOCK MINE	H	H	null	null	1	RENO	DIXIE HOT SPRINGS 15	109.
NV	39.7330	-119.039	EAGLE SALT WORKS SPRING	H	H	73	null	5	RENO	(TWO TIPS 15)	110.
NV	41.1480	-116.733	HOT LAKE	H	H	null	null	3	MCDERMITT	SQUAW VALLEY RANCH 7.5	111.
NV	41.1750	-115.278	HOT SPRING	H	H	29	null	7	WELLS	TWIN BUTTES 7.5	112.
NV	41.1450	-114.994	HOT SPRING	H	H	null	null	14	WELLS	OXLEY PEAK 7.5	113.
NV	38.8590	-119.175	HOT SPRING	H	H	null	null	4	WALKER LAKE	YERINGTON 15	114.
NV	39.8930	-116.649	LITTLE HOT SPRINGS	H	H	null	null	5	MILLETT	WALTI HOT SPRINGS 15	115.
NV	39.5590	-117.427	PETERSONS MILL HOT SPRING	H	H	null	null	3	MILLETT	MOUNT AIRY 7.5	116.
NV	39.2810	-118.420	SAND SPRINGS	H	H	75	null	6	RENO	FOURMILE FLAT 7.5	117.
NV	40.8640	-117.349	SULPHUR SPRING	H	H	null	null	6	WINNEMUCCA	BROOKS SPRING 7.5	118.
NV	41.1750	-119.957	null	H	H	36	null	17	VYA	null	119.
NV	39.2420	-116.880	null	H	H	87	null	11	MILLETT	(WILDCAT PEAK 15)	120.
NV	38.8600	-116.738	null	H	H	null	null	1	TONOPAH	(MOSQUITO CREEK 7.5)	121.

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OR	42.3380	-118.602	HOT SPRINGS	207	97	69	198	6	ADEL	BORAX LAKE 7.5	1.
OR	42.2210	-120.368	HUNTERS HOT SPRINGS	205	96	45	189	7	KLAMATH FALLS	LAKEVIEW NE 7.5	2.
OR	44.7820	-121.975	BREITENBUSH HOT SPRINGS	198	92	6	179	3	BEND	BREITENBUSH HOT SPRINGS 15	3.
OR	42.2190	-119.877	WARNER VALLEY RANCH	198	92	49	null	6	ADEL	(ADEL 7.5)	4.
OR	45.3720	-121.697	MOUNT HOOD FUMAROLES	194	90	1	177	1	THE DALLES	(MOUNT HOOD SOUTH 7.5)	5.
OR	42.1560	-120.345	BARRY RANCH HOT SPRINGS	190	88	47	189	9	KLAMATH FALLS	LAKEVIEW NE 7.5	6.
OR	44.0230	-117.460	NEAL HOT SPRINGS	189	87	75	203	7	BAKER	JAMIESON 15	7.
OR	45.0210	-122.009	AUSTIN HOT SPRINGS	186	86	4	178	1	VANCOUVER	FISH CREEK MTN. 15	8.
OR	42.6760	-118.344	MICKEY SPRINGS	187	86	null	196	4	ADEL	null	9.
OR	44.1530	-122.098	FOLEY SPRINGS	178	81	19	182	4	SALEM	MCKENZIE BRIDGE 15	10.
OR	45.2440	-117.958	HOT LAKE SPRINGS	176	80	11	null	3	GRANGEVILLE	CRAIG MOUNTAIN 7.5	11.
OR	42.5440	-118.533	ALVORD HOT SPRINGS	174	79	68	197	5	ADEL	ALVORD HOT SPRINGS 7.5	12.
OR	43.4410	-118.638	CRANE HOT SPRINGS	172	78	53	null	11	BURNS	CRANE 15	13.
OR	42.2260	-119.881	CRUMP GEYSER (CRUMP SPRING)	172	78	49	190	5	ADEL	ADEL 7.5	14.
OR	43.7270	-117.203	SNIVELY HOT SPRING	170	77	null	null	7	BOISE	OWYHEE DAM 7.5	15.
OR	42.1740	-121.615	OLENE GAP HOT SPRINGS	165	74	28	187	4	KLAMATH FALLS	(MERRILL 15)	16.
OR	43.8580	-118.544	null	165	74	null	null	3	BURNS	(VAN 15)	17.
OR	43.7080	-122.288	MCCREDIE SPRINGS	163	73	22	183	2	ROSEBURG	OAKRIDGE 15	18.
OR	43.9820	-117.233	VALE HOT SPRINGS	163	73	77	204	1	BOISE	(VALE EAST 7.5)	19.
OR	42.1620	-120.344	LEITHEAD HOT SPRING	162	72	46	189	8	KLAMATH FALLS	LAKEVIEW NE 7.5	20.
OR	44.1930	-122.049	BELKNAP SPRINGS	160	71	18	181	3	SALEM	MCKENZIE BRIDGE 15	21.
OR	43.8930	-117.501	null	158	70	76	202	3	BOISE	(HARPER 15)	22.
OR	42.2970	-119.776	FISHER HOT SPRINGS	154	68	49	191	3	ADEL	CRUMP LAKE 7.5	23.
OR	43.1850	-119.058	null	154	68	64	193	17	BURNS	null	24.
OR	43.4690	-118.202	LUCE HOT SPRINGS	145	63	84	195	10	BURNS	MCEWEN BUTTE 7.5	25.
OR	43.7190	-121.209	EAST LAKE HOT SPRINGS	144	62	33	184	2	CRESCENT	null	26.
OR	43.7630	-117.156	MITCHELL BUTTE HOT SPRING	144	62	79	null	5	BOISE	MITCHELL BUTTE 7.5	27.
OR	43.6460	-118.251	null	144	62	54	null	9	BURNS	(UPTON MOUNTAIN 7.5)	28.
OR	44.2410	-122.058	BIGELOW HOT SPRINGS	142	61	null	null	2	SALEM	(MCKENZIE BRIDGE 15)	29.
OR	45.1510	-118.659	LEHMAN SPRINGS	142	61	8	null	2	PENDLETON	LEHMAN SPRINGS 7.5	30.
OR	42.1160	-121.287	OREGON HOT SPRINGS (BIG HOT SPRING)	142	61	29	null	7	KLAMATH FALLS	MALIN 15	31.
OR	43.9440	-118.136	BEULAH HOT SPRINGS	140	60	74	null	1	BURNS	BEULAH 15	32.
OR	45.0180	-117.625	MEDICAL HOT SPRINGS	140	60	12	201	5	GRANGEVILLE	FLAGSTAFF BUTTE 7.5	33.
OR	44.9360	-122.173	BAGBY HOT SPRINGS	136	58	5	null	1	SALEM	BATTLE AX 15	34.

State	Latitude	Longitude	"Popular" or USGS Spring Name	TF	TC	P.P. 492	Circ. 790	NOAA	AMS	State	Latitude
OR	44.3540	-118.574	BLUE MOUNTAIN HOT SPRINGS	136	58	16	null	3	CANYON CITY	PRAIRIE CITY 15	35.
OR	44.9270	-117.939	RADIUM HOT SPRINGS	135	57	17	null	1	BAKER	HAINES 7.5	36.
OR	42.1880	-118.383	FLAGSTAFF BUTTE HOT SPRING	126	52	72	199	10	ADEL	null	37.
OR	44.8620	-121.201	KAHNEETA HOT SPRINGS	126	52	7	180	2	BEND	EAGLE BUTTE 7.5	38.
OR	44.8670	-121.228	SPRINGS	125	52	7	null	1	BEND	EAGLE BUTTE 7.5	39.
OR	42.0790	-117.760	null	126	52	86	200	5	JORDAN VALLEY	null	40.
OR	44.2080	-117.455	JAMIESON HOT SPRINGS	H	H	73	null	5	BAKER	(JAMIESON 15)	41.
OR	45.2060	-117.912	UNION STATION HOT SPRINGS	H	H	null	null	4	GRANGEVILLE	CRAIG MOUNTAIN 7.5	42.
OR	43.2150	-117.502	null	H	H	84	null	11	BOISE	(THE HOLE IN THE GROUND 7.	43.
OR	43.0730	-117.697	null	H	H	null	null	12	BOISE	(LAMBERT ROCKS 7.5)	44.
OR	43.5890	-117.326	null	H	H	83	null	9	BOISE	(THE ELBOW 7.5)	45.

State	Latitude	Longitude	"Popular" or USGS Spring Name	TF	TC	P.P. 492	Circ. 790	NOAA	AMS	State	Latitude
UT	40.4880	-111.911	CRYSTAL HOT SPRINGS	187	86	13	null	9	SALT LAKE CITY	JORDAN NARROWS 7.5	1.
UT	38.1860	-113.197	THERMO HOT SPRINGS	185	85	52	210	2	RICHFIELD	THERMO 15	2.
UT	38.1720	-113.204	THERMO HOT SPRINGS	181	83	52	210	3	RICHFIELD	THERMO 15	3.
UT	39.6130	-112.729	BAKER (ABRAHAM, CRATER) HOT SPRINGS	180	82	24	205	3	DELTA	BAKER HOT SPRINGS 7.5	4.
UT	38.6390	-112.098	RED HILL HOT SPRING	171	77	null	206	7	RICHFIELD	MONROE 15	5.
UT	38.6330	-112.107	MONROE (COOPER) HOT SPRINGS	169	76	48	206	8	RICHFIELD	MONROE 15	6.
UT	38.6130	-112.202	JOSEPH HOT SPRINGS	147	64	49	207	9	RICHFIELD	MONROE 15	7.
UT	39.9060	-113.430	WILSON HEALTH SPRINGS	142	61	20	null	1	DELTA	FISH SPRINGS NW 7.5	8.
UT	41.1380	-112.175	HOOPER HOT SPRINGS	140	60	null	null	14	BRIGHAM CITY	OGDEN BAY 7.5	9.
UT	41.3380	-112.031	UTAH HOT SPRINGS	138	59	6	null	11	BRIGHAM CITY	PLAIN CITY 7.5	10.
UT	41.2360	-111.924	OGDEN HOT SPRING	135	57	8	null	3	OGDEN	OGDEN 7.5	11.
UT	40.8150	-111.918	BECKS HOT SPRING	133	56	11	null	1	SALT LAKE CITY	SALT LAKE CITY NORTH 7.5	12.
UT	38.5030	-112.849	ROOSEVELT HOT SPRINGS	133	56	51	209	12	RICHFIELD	(PINNACLE PASS 7.5)	13.
UT	41.6590	-112.087	CRYSTAL (MADSENS) HOT SPRINGS	129	54	4	null	6	BRIGHAM CITY	HONEYVILLE 7.5	14.
UT	41.8550	-112.158	UDY HOT SPRINGS	124	51	3	null	2	BRIGHAM CITY	RIVERSIDE 7.5	15.

State	Latitude	Longitude	"Popular" or USGS Spring Name	TF	TC	P.P. 492	Circ. 790	NOAA	AMS	State	Latitude
WA	48.7700	-121.813	SHERMAN CRATER FUMAROLES	266	130	null	null	2	CONCRETE	(MT. BAKER 15)	1.
WA	48.7890	-121.804	DORR FUMAROLE FIELD	194	90	null	null	1	CONCRETE	(MT. BAKER 15)	2.
WA	46.1980	-122.197	MT ST HELENS FUMAROLES	190	88	12	null	2	HOQUIAM	(MOUNT ST. HELENS 15)	3.
WA	46.8520	-121.758	MT RAINIER FUMAROLES	162	72	null	null	1	YAKIMA	(MT. RAINIER WEST 7.5)	4.
WA	46.2020	-121.492	MOUNT ADAMS FUMAROLES	150	66	12	null	6	YAKIMA	(MOUNT ADAMS EAST 7.5)	5.
WA	48.1500	-121.062	GAMMA HOT SPRINGS	140	60	null	213	5	CONCRETE	GLACIER PEAK 15	6.
WA	47.4840	-121.391	GOLDMEYER HOT SPRINGS	127	53	8	null	3	WENATCHEE	SNOQUALMIE PASS 15	7.
WA	45.7010	-121.728	COLLINS HOT SPRINGS	122	50	null	null	4	THE DALLES	(HOOD RIVER 15)	8.
WA	48.9740	-119.475	HOT LAKE	122	50	null	null	1	OKANOGAN	OROVILLE 15	9.
WA	46.7380	-121.562	OHANAPECOSH HOT SPRINGS	122	50	11	214	3	YAKIMA	PACKWOOD 15	10.
WA	48.9060	-119.455	POISON LAKE	122	50	null	null	2	OKANOGAN	(OROVILLE 15)	11.
WA	47.7070	-121.155	SCENIC HOT SPRINGS	122	50	7	null	2	WENATCHEE	(SCENIC 7.5)	12.
WA	47.9690	-123.864	SOL DUC HOT SPRINGS	122	50	2	null	2	SEATTLE	BOGACHIEL PEAK 7.5	13.
WA	45.7230	-121.927	ROCK CREEK HOT SPRINGS	H	H	null	null	3	THE DALLES	BONNEVILLE DAM 15	14.

State	Latitude	Longitude	"Popular" or USGS Spring Name	TF	TC	P.P. 492	Circ. 790	NOAA	AMS	State	Latitude
WY	44.5440	-110.788	BLACK WARRIOR GROUP, SHELF SPRING	205	96	null	215	87	ASHTON	MADISON JUNCTION 15	1.
WY	44.5660	-110.871	FLAT CONE SPRING, STEEP CONE	205	96	null	215	78	ASHTON	MADISON JUNCTION 15	2.
WY	44.5710	-110.811	MORNING MIST SPRINGS	205	96	19	215	76	ASHTON	MADISON JUNCTION 15	3.
WY	44.5630	-110.834	RIVER GROUP	205	96	18	215	81	ASHTON	MADISON JUNCTION 15	4.
WY	44.5200	-110.828	FLOOD GROUP	203	95	26	215	97	ASHTON	MADISON JUNCTION 15	5.
WY	44.5680	-110.805	QUAGMIRE GROUP	203	95	null	215	77	ASHTON	MADISON JUNCTION 15	6.
WY	44.5370	-110.801	WHITE DOME GEYSER, SURPRISE POOL	203	95	22	215	90	ASHTON	MADISON JUNCTION 15	7.
WY	44.9080	-110.393	CALCITE SPRINGS	201	94	65	215	3	ASHTON	TOWER JUNCTION 15	8.
WY	44.5430	-110.859	FAIRY SPRINGS	201	94	20	215	89	ASHTON	MADISON JUNCTION 15	9.
WY	44.5540	-110.812	FOUNTAIN GROUP	201	94	null	215	83	ASHTON	MADISON JUNCTION 15	10.
WY	44.6910	-110.728	GEYSER SPRINGS GROUP	201	94	15	215	45	ASHTON	NORRIS JUNCTION 15	11.
WY	44.7220	-110.708	null	201	94	null	215	31	ASHTON	NORRIS JUNCTION 15	12.
WY	44.6930	-110.738	ARTISTS PAINTPOTS	199	93	14	215	44	ASHTON	NORRIS JUNCTION 15	13.
WY	44.7330	-110.703	CISTERN SPRING	199	93	null	215	28	ASHTON	(NORRIS JUNCTION 15)	14.
WY	44.5260	-110.835	EXCELSIOR GEYSER CRATER	199	93	25	215	95	ASHTON	MADISON JUNCTION 15	15.
WY	44.6970	-110.724	GIBBON HILL GEYSER	199	93	13	215	42	ASHTON	NORRIS JUNCTION 15	16.
WY	44.6900	-110.384	HOT SPRINGS ON BOG CREEK	199	93	79	215	47	ASHTON	CANYON VILLAGE 15	17.
WY	44.7390	-110.324	JOSEPHS COAT SPRINGS	199	93	72	215	24	ASHTON	CANYON VILLAGE 15	18.
WY	44.5660	-110.816	null	199	93	null	215	79	ASHTON	MADISON JUNCTION 15	19.
WY	44.6790	-110.746	BERYL SPRING	198	92	16	215	50	ASHTON	NORRIS JUNCTION 15	20.
WY	44.7610	-110.730	BIJAH SPRING	198	92	9	215	14	ASHTON	MAMMOTH 15	21.
WY	44.7430	-110.242	HOT SPRING BASIN GROUP	198	92	75	215	21	ASHTON	PELICAN CONE 15	22.
WY	44.5180	-110.813	HOT SPRINGS, RABBIT CREEK GROUP	198	92	26	215	98	ASHTON	MADISON JUNCTION 15	23.
WY	44.6840	-110.753	MONUMENT GEYSER BASIN	197	92	16	215	48	ASHTON	MADISON JUNCTION 15	24.
WY	44.5140	-110.828	RABBIT CREEK GROUP	198	92	null	215	99	ASHTON	MADISON JUNCTION 15	25.
WY	44.7860	-110.740	SEMI-CENTENNIAL GEYSER	198	92	7	215	8	ASHTON	MAMMOTH 15	26.
WY	44.5300	-110.297	STEAMBOAT SPRINGS	198	92	95	215	93	ASHTON	CANYON VILLAGE 15	27.
WY	44.5440	-110.258	TURBID SPRINGS	198	92	94	215	88	ASHTON	CANYON VILLAGE 15	28.
WY	44.7970	-110.725	AMPHITHEATER SPRINGS	196	91	7	215	7	ASHTON	MAMMOTH 15	29.

State	Latitude	Longitude	"Popular" or USGS Spring Name	TF	TC	P.P. 492	Circ. 790	NOAA	AMS	State	Latitude
WY	44.7560	-110.308	COFFEE POT HOT SPRINGS	196	91	73	215	15	ASHTON	TOWER JUNCTION 15	30.
WY	44.5910	-110.321	HOT SPRINGS AT SULPHUR HILLS	196	91	89	215	72	ASHTON	CANYON VILLAGE 15	31.
WY	44.5560	-110.832	RIVER GROUP	196	91	null	215	82	ASHTON	MADISON JUNCTION 15	32.
WY	44.7660	-110.429	WASHBURN HOT SPRINGS	196	91	50	215	12	ASHTON	TOWER JUNCTION 15	33.
WY	44.6810	-110.326	HOT SPRINGS ON UPPER SOUR CREEK	194	90	null	215	49	ASHTON	CANYON VILLAGE 15	34.
WY	44.5320	-110.796	FIVE SISTERS SPRINGS	192	89	null	215	92	ASHTON	MADISON JUNCTION 15	35.
WY	44.5320	-110.874	IMPERIAL GEYSER, SPRAY GEYSER	192	89	24	215	91	ASHTON	MADISON JUNCTION 15	36.
WY	44.5640	-110.869	QUEENS LAUNDRY	192	89	17	215	80	ASHTON	MADISON JUNCTION 15	37.
WY	44.6530	-110.482	SULPHUR SPRINGS	194	89	61	215	57	ASHTON	CANYON VILLAGE 15	38.
WY	44.7020	-110.767	SYLVAN SPRINGS	192	89	12	215	40	ASHTON	MADISON JUNCTION 15	39.
WY	44.7280	-110.701	null	192	89	null	215	29	ASHTON	NORRIS JUNCTION 15	40.
WY	44.7690	-110.269	RAINBOW SPRINGS	190	88	null	215	11	ASHTON	TOWER JUNCTION 15	41.
WY	44.6280	-110.433	SULPHUR CALDRON	190	88	61	215	61	ASHTON	CANYON VILLAGE 15	42.
WY	44.7520	-110.418	HOT SPRINGS AT SEVENMILE HOLE	189	87	52	215	18	ASHTON	TOWER JUNCTION 15	43.
WY	44.5210	-110.275	BUTTE SPRINGS	187	86	96	215	96	ASHTON	CANYON VILLAGE 15	44.
WY	44.7330	-110.712	HORSESHOE SPRING	187	86	null	215	27	ASHTON	(NORRIS JUNCTION 15)	45.
WY	44.6900	-110.750	null	187	86	null	215	46	ASHTON	NORRIS JUNCTION 15	46.
WY	44.7220	-110.701	ECHINUS GEYSER	185	85	11	215	32	ASHTON	NORRIS JUNCTION 15	47.
WY	44.6970	-110.375	HOT SPRINGS ON BOG CREEK	185	85	79	215	43	ASHTON	CANYON VILLAGE 15	48.
WY	44.5290	-110.791	WHITE CREEK GROUP	185	85	null	215	94	ASHTON	(MADISON JUNCTION 15)	49.
WY	44.2440	-111.022	BOUNDARY CREEK HOT SPRINGS	181	83	null	215	1	ASHTON	WARM RIVER BUTTE 15	50.
WY	44.6710	-110.290	PONUNTPA SPRINGS GROUP	180	82	83	215	53	ASHTON	CANYON VILLAGE 15	51.
WY	44.7140	-110.475	null	167	75	null	215	35	ASHTON	CANYON VILLAGE 15	52.
WY	44.9670	-110.708	MAMMOTH HOT SPRINGS	163	73	2	215	2	ASHTON	MAMMOTH 15	53.
WY	43.9580	-110.696	JACKSON LAKE HOT SPRINGS	162	72	null	null	1	DRIGGS	(COLTER BAY 7.5)	54.
WY	44.7530	-110.724	ROADSIDE SPRINGS, FRYING PAN SPRING	158	70	9	215	17	ASHTON	MAMMOTH 15	55.
WY	44.5980	-110.236	HOT SPRINGS IN PELICAN VALLEY	156	69	null	215	70	ASHTON	PELICAN CONE 15	56.
WY	44.7540	-110.403	SEVENMILE HOLE	154	68	null	215	16	ASHTON	(TOWER JUNCTION 15)	57.
WY	44.7390	-110.258	HOT SPRING BASIN GROUP	153	67	75	215	25	ASHTON	CANYON VILAGE 15	58.

State	Latitude	Longitude	"Popular" or USGS Spring Name	TF	TC	P.P. 492	Circ. 790	NOAA	AMS	State	Latitude
WY	42.8280	-110.999	AUBURN HOT SPRINGS	144	62	103	218	1	PRESTON	null	59.
WY	44.7810	-110.699	WHITEROCK SPRINGS	144	62	8	215	10	ASHTON	MAMMOTH 15	60.
WY	44.7200	-110.715	null	144	62	null	215	33	ASHTON	NORRIS JUNCTION 15	61.
WY	44.5820	-110.314	VERMILION SPRINGS	140	60	91	215	74	ASHTON	CANYON VILLAGE 15	62.
WY	44.5880	-110.341	EBRO SPRINGS	136	58	90	215	73	ASHTON	CANYON VILLAGE 15	63.
WY	44.5500	-110.805	FOUNTAIN PAINT POT	136	58	21	215	86	ASHTON	MADISON JUNCTION 15	64.
WY	44.9850	-110.689	HOT RIVER	136	58	1	215	1	ASHTON	MAMMOTH 15	65.
WY	43.6540	-108.194	THERMOPOLIS HOT SPRINGS	133	56	111	null	1	THERMOPOLIS	THERMOPOLIS 7.5	66.
WY	44.6250	-110.433	MUD VOLCANO	131	55	61	215	62	ASHTON	CANYON VILLAGE 15	67.
WY	42.5450	-106.725	ALCOVA HOT SPRINGS	129	54	113	null	1	CASPER	(ALCOVA 7.5)	68.
WY	41.4500	-106.804	SARATOGA HOT SPRINGS	129	54	115	null	1	RAWLINS	SARATOGA 7.5	69.
WY	44.7110	-110.741	CHOCOLATE POTS	124	51	null	215	36	ASHTON	NORRIS JUNCTION 15	70.
WY	44.8420	-110.732	APOLLINARIS SPRING	H	H	null	215	4	ASHTON	MAMMOTH 15	71.
WY	44.5530	-110.301	BEACH SPRINGS	H	H	93	215	84	ASHTON	CANYON VILLAGE 15	72.
WY	44.7080	-110.461	FOREST SPRINGS	H	H	54	215	39	ASHTON	CANYON VILLAGE 15	73.
WY	44.7500	-110.714	GAS VENT	H	H	null	215	20	ASHTON	MAMMOTH 15	74.
WY	44.6120	-110.618	GAS VENT	H	H	null	215	65	ASHTON	NORRIS JUNCTION 15	75.
WY	44.7410	-110.699	GAS VENT	H	H	null	215	23	ASHTON	NORRIS JUNCTION 15	76.
WY	44.6010	-110.632	GAS VENT EAST OF MARY LAKE	H	H	null	215	68	ASHTON	NORRIS JUNCTION 15	77.
WY	44.7150	-110.555	GAS VENTS	H	H	null	215	34	ASHTON	NORRIS JUNCTION 15	78.
WY	44.8250	-110.675	GAS VENTS AT HORSESHOE HILL	H	H	null	215	6	ASHTON	MAMMOTH 15	79.
WY	44.5950	-110.622	GAS VENTS SOUTHEAST OF MARY LAKE	H	H	null	215	71	ASHTON	NORRIS JUNCTION 15	80.
WY	44.6160	-110.616	HIGHLAND HOT SPRINGS	H	H	57	215	64	ASHTON	NORRIS JUNCTION 15	81.
WY	44.7520	-110.256	HOT SPRING	H	H	null	215	19	ASHTON	TOWER JUNCTION 15	82.
WY	44.6420	-110.238	HOT SPRING	H	H	null	215	58	ASHTON	PELICAN CONE 15	83.
WY	44.7660	-110.300	HOT SPRINGS	H	H	null	215	13	ASHTON	TOWER JUNCTION 15	84.
WY	44.5720	-110.691	HOT SPRINGS	H	H	27	215	75	ASHTON	NORRIS JUNCTION 15	85.
WY	44.6100	-110.438	HOT SPRINGS	H	H	null	215	66	ASHTON	CANYON VILLAGE 15	86.
WY	44.6670	-110.282	HOT SPRINGS	H	H	null	215	54	ASHTON	CANYON VILLAGE 15	87.
WY	44.6720	-110.236	HOT SPRINGS	H	H	null	215	51	ASHTON	PELICAN CONE 15	88.
WY	44.7110	-110.468	HOT SPRINGS	H	H	null	215	37	ASHTON	CANYON VILLAGE 15	89.
WY	44.6070	-110.617	HOT SPRINGS EAST OF MARY LAKE	H	H	59	215	67	ASHTON	NORRIS JUNCTION 15	90.
WY	44.6170	-110.432	MUD GEYSERS	H	H	61	215	63	ASHTON	CANYON VILLAGE 15	91.
WY	44.5510	-110.850	SPRINGS ON FAIRY CREEK	H	H	null	215	85	ASHTON	MADISON JUNCTION 15	92.
WY	44.7810	-110.738	STEAM VENTS AT ROARING MOUNTAIN	H	H	null	215	9	ASHTON	MAMMOTH 15	93.
WY	44.6340	-110.234	THE MUDKETTLES	H	H	87	215	59	ASHTON	PELICAN CONE 15	94.
WY	44.6340	-110.226	THE MUSHPOTS	H	H	88	215	60	ASHTON	PELICAN CONE 15	95.
WY	44.6560	-110.572	VIOLET SPRINGS	H	H	56	215	56	ASHTON	NORRIS JUNCTION 15	96.

Appendix G

Ecoregion Divisions

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APPENDIX G
ECOREGION DIVISIONS

The descriptions in this appendix were adapted from the United States Forest Service "Description of Ecoregions of the United States," compiled by Roger G. Bailey in 1995 with the exception of the ecoregions unique to Alaska which were adapted from "Description of Ecological Subregions: Sections of the Conterminous United States," compiled by W. H. McNab, D. T. Cleland, J. A. Freeouf, J. E. Keys, Jr., G. J. Nowacki, and C. A. Carpenter in 2007.

POLAR DOMAIN

Arctic Division

The northern continental fringes of North America, from the Arctic Circle northward to about the 75th parallel, lie within the outer zone of control of arctic air masses. This produces the arctic climate. The average temperature of the warmest month lies between 50F (10C) and 32F (0C).

The arctic climate has a very short, cool summer and a long, severe winter. No more than 188 days per year, and sometimes as few as 55, have a mean temperature higher than 32F (0C). Annual precipitation is light, often less than 8 inches (200 mm), but because potential evaporation is also very low, the climate is humid.

Vegetation on the tundra consists of grasses, sedges, lichens, and willow shrubs. As one moves south, the vegetation changes into birch-lichen woodland, and then into needleleaf forest. In some places, a distinct tree line separates forest from tundrauses this line, which coincides approximately with the 50F (10C) isotherm of the warmest month, as a boundary between subarctic and arctic climates.

Wildlife species in arctic habitats fall into three categories: 1) resident species that remain active year-round, 2) resident species hibernating in winter such as the polar bear, and 3) migratory species present for only a portion of the year. Resident species that remain active year-round include the willow ptarmigan, common raven, snowy owl, Arctic fox, brown lemming, muskoxen, and caribou. Hibernating species include the Arctic ground squirrel, and hoary marmot. The great majority of the approximately 100 bird species using the arctic are migratory.

Except for the wood frog, there are no amphibians or reptiles in the Arctic Ecoregion. Because they are cold-blooded animals, the climate is too cold for these groups. Wood frogs are unique in that they partially freeze in winter; up to one-third of the water in a wood frog's body may turn to ice for a period of several weeks.

The arctic has low species diversity; arctic insect fauna, for example, is only one percent to five percent as rich in species as the insect fauna found at temperate latitudes. Wildlife populations are also constrained by the low plant productivity, and can fluctuate greatly in response to annual changes in plant productivity. Animal population peaks can markedly alter vegetation and other habitat features in some instances, leading to sharp declines in population numbers.

Insect fauna provides an important prey base for migratory shorebirds and waterfowl. To cope with the short summer and limited food supplies, migratory birds tend to nest almost immediately upon arriving on the breeding grounds, and young hatch when insects and vegetation are most abundant.

Brant and common eider are prevalent in this area. Seabirds such as the pomarine jaeger, glaucous gull, and black guillemot are characteristic breeders. The semipalmated sandpiper is a common breeder in this section as is the rare Arctic Loon. The breeding range of the rare curlew sandpiper is limited to the tundra adjacent to the coast. Waterfowl, other small birds, and small mammals are preyed upon by Arctic fox, snowy owl, gyrfalcons, peregrine falcons, and rough-legged hawks.

Suitable habitat for denning or burrowing species may be limited in areas with continuous or near-continuous permafrost. Burrowing species must select areas where the permafrost is not near the surface. The presence of deep snowdrifts is important for denning wolverines, polar bears, and brown bears. Talus slopes and cut banks are important habitat features used by denning Arctic foxes. Raptors tend to nest along river and coastal bluffs because of the generally flat, treeless character of the Arctic tundra. Pink and chum salmon are present in this Section as are king, sockeye, and Coho salmon.

Soil particles in the arctic derive almost entirely from mechanical breakup of rock, with little or no chemical alteration. Inceptisols with weakly differentiated horizons are dominant. Continual freezing and thawing of the soil have disintegrated its particles. Like the northern continental interior, the arctic has a permanently frozen sublayer of soil known as permafrost. The permafrost layer is more than 1,000 feet (300 m) thick throughout most of the region; seasonal thaw reaches only 4-24 inches (10-60 cm) below the surface.

Geomorphic processes are distinctive in the arctic, resulting in a variety of curious landforms. Under a protective layer of sod, water in the soil melts in summer to produce a thick mud that sometimes flows downslope to create bulges, terraces, and lobes on hillsides. The freeze and thaw of water in the soil sorts out coarse particles, giving rise to such patterns in the ground as rings, polygons, and stripes made of stones. The coastal plains have numerous lakes of thermokarst origin, formed by melting groundwater.

Arctic Tundra Province

Land-surface form.--The north coast of Alaska is a broad, level plain that is generally less than 1,000 feet (300 m) in elevation. Rolling foothills rise near the Colville River and gain altitude southward into the Brooks Range. In summer, thousands of lakes and marshes dot the plain.

Climate.--The severe arctic climate reaches temperatures of -60F (-51C) in winter. Average annual temperature is only 10 to 20F (-12C to -6C). Due to its location in the extreme north, this province gets very different amounts of sunlight at different times of year. In summer, the sun remains above the horizon 24 hours a day for from 2 to 85 consecutive days, depending on the latitude; in winter, it can remain below the horizon 24 hours a day for as long as 67 consecutive days. All sunlight is received at oblique angles that average 41 degrees. The growing season averages only two weeks per year. Precipitation is very low throughout the year; average annual precipitation is only seven inches (180 mm).

Vegetation.--Permafrost limits the rooting depth of plants and forces surface water to drain by preventing it from seeping into the soil. Extensive marshes and lakes result. Cottongrass-tussock, the most widespread vegetation system in the Arctic, is associated with sedges, dwarf shrubs, lichens, mosses, dwarf birch, Labrador-tea, and cinquefoil. These highly productive systems produce 500-1,000 lb (227-454 kg) of vegetation per acre, an important source of food for caribou and waterfowl. Several forbs flower brightly in the short summer.

Soils.--The soils are wet, cold Inceptisols with weakly differentiated horizons. Soils on south slopes and low moraines are well drained and loamy, with permafrost and ice features. They are underlain by coarse outwash and till. The uplands have localized areas of poorly drained clayey soils; lowland soils are deep, wet, and silty. There is no surface water in winter and only moderate flows in summer. Supplies of ground water are very limited. The entire province is under continuous permafrost to depths of 2,000 feet (600 m) in some areas.

Fauna.--Mammals of the Arctic include brown bear, wolf, wolverine, caribou, arctic hare, mink, weasel, and lemming. Polar bear, walrus, and arctic fox are common on the ice pack and coastal areas during winter.

Shore and lake areas provide rich habitat for millions of migrating waterfowl and shore birds during the summer months. Ptarmigans, ravens, hawks, and open country owls are common. Gyrfalcons have also been seen on sea ice.

Brooks Range Tundra

Land-surface form.--The Brooks Range, a northern extension of the Rocky Mountains, reaches 600 miles (970 km) westward from Canada to the Chukchi Sea. Its rugged peaks reach elevations of 9,000 feet (2,700 m) in the east, falling to 3,000 feet (900 m) in the west. Broad U-shaped valleys, morainal topography, and braided stream channels show evidence of glaciation. A series of rolling plateaus and low mountains, the arctic foothills, borders the coastal plain to the north.

Climate.--The climate of the Brooks Range is similar to that of the arctic coastal plain, but precipitation increases at the higher altitudes and at the east end of the range. Summer temperatures reach 90 to 100F (32 to 38C), and winter temperatures drop as low as -75F (-60C). Because the province lies above the Arctic Circle, it gets several days of 24-hr sunlight in June, and several sunless days in December. Precipitation averages 7 to 15 inches (180 to 390 mm), but drainage is rapid due to the area's steep slopes and the low holding capacity of its soils.

Vegetation.--In the higher alpine areas, plant cover is discontinuous over barren rock. It consists chiefly of low mats of such herbaceous and shrubby species as dwarf arctic birch, crowberry, Labrador-tea, arctic willow, resin birch, and dwarf blueberry. Areas at lower elevations may be covered by a mat of sedge and shrub that provides valuable forage for caribou. Cottongrass, bluejoint, mosses, dwarf willow, dwarf birch, Labrador-tea, and bistort are common. Regeneration is extremely slow for most species; some mosses require more than 60 years to recover from disturbance.

Soils.--The mountains are underlain by folded and faulted limestone, the foothills by various sediments. Soils are rocky and poorly developed. Inceptisols cover the lower slopes. Glacial and alluvial deposits occur in the valleys and at the base of the mountain slopes. Permafrost is continuous under the entire area.

Fauna.--The Brooks Range is an important big-game area in Alaska, supporting brown and black bear, wolf, wolverine, caribou, and Dall sheep. Smaller mammals include marmot, red and arctic fox, ground squirrel, lemming, and pika.

The Brooks Range is an important resting area for migrating waterfowl and songbirds during summer. Raptors prominent in many areas include golden eagles, marsh hawks, gyrfalcons, and snowy and other open country owls.

Bering Sea Tundra Province

Land-surface form.--The Bering Sea Tundra is a western extension of the arctic coastal plain, a broad lowland area rising gradually to the east. General topography is less than 1,000 feet (300 m) in elevation, broken in places by small mountain groups that rise 2,500-3,500 feet (800-1,100 m). Standing water is present in thousands of shallow lakes and marshes along the coast. Two large braided rivers, the lower Yukon and the Kuskokwim, flow out of the province to the southwest.

Climate.--The climate is less severe in the Bering Sea Tundra than on the arctic slope, but it also has cold winters and generally cool summers. Temperatures range from a high of 90F (32C) in summer to a low of -70F (-57C) in winter. Annual precipitation averages 17 inches (430 mm).

Vegetation.--Vegetation along the wet coastal areas is chiefly sedge and cottongrass; woody plants grow on higher sites. Birch-willow-alder thickets are extensive in transition zones between beach and forest. The lower Yukon and Kuskokwim Valleys are dominated by white spruce mixed with cottonwood and balsam poplar in tall, relatively dense stands, with a dense undergrowth of thinleaf alder, willow, rose, dogwood, and various species of berry bushes.

Soils.--Coastal soils are wet, cool Inceptisols over silt, sand, and marine sediments. The lower Yukon and Kuskokwim Valley bottoms have pockets of Entisols with no soil horizons. Ground water throughout the area is limited, but some is present in the major river valleys. Surface water on the Seward Peninsula ceases to flow in winter, but further south it flows year-round. Permafrost is continuous under most of the area.

Fauna.--River bottom lands provide excellent habitat for furbearers, game birds, and moose. Upland and coastal areas support brown and black bear, wolf, wolverine, coyote, caribou, reindeer, snowshoe hare, red fox, lynx, beaver, moose, squirrels, mice, weasel, mink, and marten. Along the northern Bering Sea coast, polar bear, walrus, and arctic fox are occasionally found.

Coastal areas provide extensive and excellent habitat for migrating waterfowl and shore birds. Other bird species in the area include ospreys, falcons, grouse, ravens, golden eagles, and various hawks and owls.

Subarctic Division

The source region for the continental polar air masses is south of the tundra zone between latitude 50 and 70 N. The climate type here shows very great seasonal range in temperature; winters are severe, and the region's small amounts of annual precipitation are concentrated in the three warm months. This cold, snowy forest climate, referred to in this volume as the boreal subarctic type, is classified as E in the Koppen-Trewartha system. This climate is moist all year, with cool, short summers. Only one month of the year has an average temperature above 50F (10C).

Winter is the dominant season of the boreal subarctic climate. Because average monthly temperatures are subfreezing for six to seven consecutive months, all moisture in the soil and subsoil freezes solidly to depths of many feet. Summer warmth is insufficient to thaw more than a few surface feet, so permafrost prevails under large areas. Seasonal thaw penetrates from 2 to 14 feet (0.6 to 4 m), depending on latitude, aspect, and kind of ground. Despite low temperatures and long winters, the valleys of interior Alaska were not glaciated during the Pleistocene, probably because of insufficient precipitation.

The subarctic climate zone coincides with a great belt of needleleaf forest, often referred to as boreal forest, and with the open lichen woodland known as taiga. Most trees are small, with less value as lumber than as pulpwood.

Boreal forests are structurally more complex than tundra, and thus support a greater diversity of wildlife species. These forests provide habitat for large mammals, such as grizzly bear, black bear, wolf, moose, and wolverine; small mammals, such as red fox, American beaver, American marten, and weasels; birds, such as spruce and ruffed grouse, owls, and raven; and the amphibian, wood frog. Cliffs along the Yukon and Porcupine Rivers provide habitat for several raptor species: osprey, gyrfalcon, hawks, and the endangered American peregrine falcon. Rich fish resources support bald eagles and osprey on the coastline. Many species have unique adaptations to survive in subarctic forests. Herbivores typically graze on herbaceous and shrubby vegetation during the summer, but shift to a high fiber diet of conifer needles and woody shrub browse during winter. White-winged crossbills are an example of a species that have adapted to the abundant cone seeds in boreal forests. These birds move in large flocks when cone supplies are abundant, but are nomadic when cone supplies are limited. White-winged crossbills also breed opportunistically, when cone supplies are most abundant. The boreal forests also provide a rich source of lichen, a food-source that comprises 60-80 percent of the winter diet for barren-ground caribou.

There are fewer wildlife species are found in bogs of the subarctic ecoregion than in upland forests, given the lack of diversity in flora. The high water table of bogs also discourages burrowing species.

The arctic needleleaf forest grows on Inceptisols with pockets of wet, organic Histosols. These light gray soils are wet, strongly leached, and acid; they form a very distinct layer beneath a topsoil layer of humus and forest litter. Agricultural potential is poor, due to the natural infertility of soils and the prevalence of swamps and lakes left by departing ice sheets. In some places, ice scoured rock surfaces bare, entirely stripping off the overburden. Elsewhere rock basins were formed and stream courses dammed, creating countless lakes.

Yukon Intermontane Taiga Province

Land-surface form.--A series of broad valleys, dissected uplands, and lowland basins covered with alluvial deposits extends across interior Alaska between the Brooks and Alaska Ranges. Four major rivers, the Yukon, Tanana, Koyukuk, and upper Kuskokwim, provide the area's outstanding hydrologic features. All four form wide valleys, with extensively braided channels; in some areas, the valleys contain hundreds of small lakes and marshes. Elevations are generally less than 2,000 feet (600 m).

Climate.--The semiarid climate has extreme temperatures. Summers are short and hot, with temperatures up to 100F (38C); winters are long and severe, with temperatures as low as -75F (-60C). Average annual precipitation is only 17 inches (430 mm). Temperature inversions, frequent in upland areas in winter, result in warmer temperatures on lower slopes than in bottom lands.

Vegetation.--The major river bottoms support dense white spruce-cottonwood-poplar forests on floodplains and southfacing slopes up to about 1,000 feet (300 m). The undergrowth is dense shrubbery formed by green and thinleaf alder, willow, dogwood, and berries. The outer valley edges support evergreen and coniferous forests, often with pure stands of black spruce. The undergrowth consists of willow, dwarf birch, crowberry, fern, blueberry, lichens, and mosses. Upland areas are generally covered by a rather dense white spruce-birch-aspen-poplar forest. Pure stands of white spruce grow near streams. Typical undergrowth includes willow, alder, fern, berries, grasses, and mosses. Root systems are shallow. Water balance is likely the factor limiting growth in most of these areas because of the hot, dry summer climate. Old river terraces, ponds, and sloughs contain scattered but extensive bogs where the vegetation is chiefly sphagnum and other mosses, sedges, bog rosemary, and Labrador-tea. Marginal areas may support willow and alder.

Soils.--River bottom and lower slope soils are generally deep, well-drained Inceptisols over sands, silts, and gravels that are only slightly weathered. Permafrost is discontinuous in major river valleys. Soils on northfacing slopes are shallow and poorly developed, with continuous permafrost. Upland soils that support spruce-hardwood forests are well-drained, shallow Inceptisols over continuous permafrost. Bog soils are Histosols.

Fauna.--The spruce-hardwood forests provide excellent habitat for furbearers and other mammals. Brush zones and immature forests recovering from fires furnish especially good browse for moose. Common game animals in addition to moose include black and brown bear, wolf, wolverine, and caribou. Smaller mammals include lynx, red fox, beaver, mink, muskrat, weasel, river otter, marten, red and northern flying squirrel, and deer mouse. Woodland game birds find plentiful habitat. Upland birds include northern hawk-owl, spruce grouse, and boreal chickadee.

Upper Yukon Taiga Province

Land-surface form.--This province is mostly a flat plains and rounded low mountains. The plains consist of marshy lake-dotted flats rising from 300 feet (90 m) in altitude in the west to 600-900 feet (180-270 m) in the north and east. The mountains rise to 4,000 feet (600-1,200 m). The province is made up of outwash fans and floodplains of the Chandalar, Christian, Sheenjek, and Upper Yukon Rivers. Rolling silt- and gravel-covered marginal terraces with sharp escarpments 150-600 feet (50-180 m) high rise above the flats, sloping gradually upward to altitudes of about 1,500 feet (460 m) at the base of surrounding uplands and mountains.

Climate.--The climate is the extreme continental boreal type, with its large annual temperature range, severely cold winters, and short, hot summers. The average daily minimum temperature of the coldest month is -29F (-33C). At Fort Yukon, more than 130 days per year have a minimum temperature of 0F (-18C) or below. The record low at Fort Yukon is -78F (-61C), and the record high is 100F (38C). The growing season is less than 3 months. The region is semiarid, with an average annual precipitation of about seven inches (179 mm), with a summer maximum. Snowfall averages 45 inches (1,150 mm) per year.

Vegetation.-- The vegetation pattern in the area is complex. Bottom land spruce-aspen-birch grow on the better drained alluvial sites. Alder and willow form thickets on newly exposed alluvial sites subject to periodic flooding. Forests of white spruce, paper birch, and quaking aspen cover most lower slopes in the south and southfacing slopes in the north. Black spruce forest vegetation grows at higher elevations, on all northfacing slopes in the south, on all but steep southfacing slopes in the north, and on lower slopes with impeded soil drainage throughout the area. Above the black spruce forest, the vegetation is alpine meadow characterized by sedges on poorly drained sites and by low-growing shrubs on drier sites.

Soils.--Principal soils are wet Inceptisols, mostly in flats and low areas. Lower parts of the floodplains are poorly drained and covered with peat, whereas river terraces are better drained.

Fauna.--The fauna of the Yukon Flats Province are similar to those in other taiga regions. But this province provides what may be the most productive arctic habitat for avian wildlife on the continent. Predominant waterfowl species that breed in the region include the lesser scaup, pintail, scoter, and wigeon. The area supports 15-20 percent of remaining canvasbacks. Arctic, red-throated, and common loons, horned and red-necked grebes, and sandhill cranes are also common. Cliffs along the Yukon and Porcupine Rivers support several raptor species, including osprey, gyrfalcon, Swainson's hawk, and the endangered American peregrine falcon.

Alaska Range Taiga

Land-surface form--The Alaska Range is a continuation of the Pacific Coast Mountains extending in an arc across the northern Pacific. The towering, glaciated peaks of the Wrangell Mountains and of the Alaska Range--which includes Mt. McKinley at 20,320 feet (6,194 m)--typify the ruggedness of the area. The only major waterways are the Susitna and upper Copper Rivers.

Climate.--The Alaska Range and the Wrangell Mountains have a transitional climate of severe winters and hot, dry summers. Temperatures range from 90F to -70F (32C to -57C). Precipitation averages only 16 inches (410 mm) annually.

Vegetation.--Vertical vegetational zonation characterizes the Alaska Range and Wrangell Mountains, beginning with dense bottom-land stands of white spruce and cottonwood on the floodplains and low terraces of the Copper and Susitna Rivers. Above the terraces, poorly drained areas up to 1,000 feet (300 m) support stands of black spruce. Upland spruce-hardwood forests of white spruce, birch, aspen, and poplar, with an undergrowth of moss, fern, grass, and berry, extend to timberline at about 2,500-3,500 feet (800-1,100 m). Tundra systems of low shrubs and herbaceous plants form discontinuous mats among the rocks and rubble above timberline. White mountain-avens may cover entire ridges in the Alaska Range, associated with moss campion, black oxytrope, arctic sandwort, lichens, grasses, and sedges. These tundra systems stop short of the permanent ice caps on the highest peaks.

Soils.--Bottom-land and terrace soils of the Copper and Susitna Rivers are stratified, well-drained Entisols without pedogenic horizons. Upland hardwood forest soils are mostly shallow, well-drained Inceptisols. Permafrost is continuous on northfacing slopes, discontinuous on southfacing ones. Soils that support the moister tundra areas range from wet Inceptisols to Histosols. Alpine Inceptisols are generally shallow and poorly developed, with discontinuous or continuous permafrost.

Fauna.--The Alaska Range supports large big-game populations of moose, Dall sheep, black and brown bear, wolf, caribou, and wolverine. Smaller mammals include beaver, red fox, lynx, otter, marten, squirrels, and weasel. Golden eagles, ptarmigan, ravens, and sharp-shinned hawks inhabit the uplands. Near timberline in Lake Clark National Park, Alaska Range.

HUMID TEMPERATE DOMAIN

Warm Continental Division

South of the subarctic climate lies the humid warm-summer continental climate. Located squarely between the source regions of polar continental air masses to the north and maritime air masses to the south, it is subject to strong seasonal contrasts in temperature as these air masses push back and forth across the land.

It has a cold snowy winter climate with a warm summer. The climate has four to seven months when temperatures exceed 50F (10C), with no dry season. The average temperature during the coldest month is below 32F (0C). The warm summer has an average temperature during its hottest month that does not exceed 72F (22C). Precipitation is ample all year, but is substantially greater during the summer.

Needleleaf and mixed needleleaf-deciduous forest grows throughout the colder northern parts of the humid continental climate zone, extending into the mountain regions north of Cook Inlet.

Alaska Mixed Forest Province

Land-surface form.--This province is a moraine- and outwash-mantled lowland that rises from sea level to an altitude of 2,000 feet (600 m). Drained by the Nushagak and other large rivers that flow into Bristol Bay, the lowland is dotted with morainal and thaw lakes. The Copper River lowland is also part of the province. It is a broad basin of rolling to hilly moraines and nearly level alluvial plains on the site of a Pleistocene glacial lake.

Climate.--This province has a marine phase of the tundra climate, with cold winters and cool, short summers. Although the climate is subarctic, it is less severe than the interior of Alaska, because much of the region is sheltered by the Alaska Range to the north. Proximity to the Gulf of Alaska makes the climate transitional to the marine climates to the south. Average annual temperatures range from 32 to 39F (0 to 4C), with a winter average of about 5F (-15C) and summer maximums of about 64F (18C). Average annual precipitation ranges from 10 to 18 inches (260 to 460 mm). Annual snowfall averages from 4 to 10 inches (100 to 260 mm).

Vegetation.-- Throughout the Cook Inlet lowlands, lowland spruce-hardwood forests are abundant. Bottom land spruce-poplar forest adjoins the larger river drainages, along with thickets of alder and willow. Wet tundra communities exist along the Cook Inlet coastline. The Copper River lowland is characterized by black spruce forest interspersed with large areas of brushy tundra. White spruce forests occur on southfacing gravelly moraines, and cottonwood-tall bush communities are common on large floodplains.

Soil.--Dominant soils are Inceptisols. Most soils are formed in ash deposits of various thickness, underlain by gravelly glacial till, outwash deposits, or silty alluvium. Coastal plain soils are formed in gravelly alluvium, cinders, or weathered rock blanketed by thick sedge peat. Spodosols are the principal upland soils in the Cook Inlet. Permafrost is sporadic or absent.

Fauna.-- The diversity of habitats in this province supports a large variety of species. Muskrats and red foxes abound, moose flourish in lowland areas, and Dall sheep are frequently seen in the uplands. Black bear populations are dense throughout the region. Trumpeter swans nest here, and tundra swans are present during migration. King, sockeye, and Coho salmon are common or abundant. Brown bears are common mammals, partly because of large salmon runs in this area. Bristol Bay provides staging and migration habitat for large numbers of waterfowl. Ospreys occur more frequently in this province than in any other part of Alaska. Blackpoll warblers are common breeders in conifer stands in the north.

Cold Oceanic Division

The Cold Oceanic division includes much of the Alaska Peninsula and all of the Aleutian Islands. The islands that chiefly make up this province are mountainous, rising steeply from the sea. The Islands and the Alaska peninsula experience a maritime climate. Precipitation varies widely, from 20 to 82 inches. Generally, larger islands receive more precipitation than smaller ones, and coastal areas more than inland areas. Temperatures range from average lows of 20 to -4F in winter to average highs of 50 to 55F in summer

Trees are absent from the division and vegetation consists of low shrubs of willow, birch, and alder interspersed with lichen, and grass communities. At lower elevations, there is a luxuriant growth of tall grasses, flowering plants, and ferns, with thickets of low willows in some places. A little higher up, several types of heath cover vast areas. The boreal forest and coastal rainforest are slowly encroaching from the east on the area of this province. This is explained by the assumption that the distribution of the vegetation is not yet adjusted to the climatic conditions produced by retreat of the last continental glaciers Alpine tundra is found on mountainsides.

The division supports many seabird colonies of extraordinary size and global importance. The Pribilof Islands, for example, provide breeding habitat for approximately three million seabirds including virtually all of the world's 250,000 red-legged kittiwakes. Many of the islands also support endemic species, including the Pribilof Island shrew and the Aleutian shield fern, the only federally-listed endangered plant in Alaska.

The division has most soils form of volcanic ash or cinders over basaltic rock, and dominant soil types are Typic Haplocryands and Typic Vitricryands. Higher elevations often are covered in bare rock and basaltic rubble.

Aleutian Meadow Province

Land-surface form.--The islands that chiefly make up this province are mountainous, rising steeply from the sea. They contain more than 75 volcanoes, about half of which are know to have erupted during the last 200 years. Altitudes of the volcanoes decrease southwestward from 7,500 feet (2,300 m) at Mount Katmai on the Alaska Peninsula to 6,000 feet (1,800 m) on the Aleutian Islands. Not much of the land on the islands or on the peninsula is level. Steep slopes prevail all the way to water's edge, and shores are rocky and craggy. The Alaska Peninsula has intensely glaciated mountains indented with fjords that are bordered by cliffs. Several large lakes are on the peninsula.

Climate.--The climate is similar to that on the arctic coastal plain, except it is a marine phase (described above for the Bering Tundra Province). Winters are less severe than those on the coastal plain, with temperature ranges of 18 to 27F (10 to 15C), as compared to a 54F (30C) range on the coastal plain. The climate is characterized by fog and rain, with the amount of precipitation varying little from month to month. Annual precipitation varies from 21 inches (530 mm) to more than 78 inches (2,000 mm). In general, smaller islands receive less precipitation than larger islands. Winds are often severe on the islands. Pacific Ocean water moving northward through the straits between the islands produces complex mixing with Bering Sea water, including upwelling. The Pribilof Islands in the Bering Sea are about at the southern limit of the arctic ice pack in winter.

Vegetation.--Trees are absent from the Aleutian Province, although there are a few shrubs, chiefly dwarf willows. At lower elevations, there is a luxuriant growth of tall grasses, flowering plants, and ferns, with thickets of low willows in some places. A little higher up, several types of heath cover vast areas. The boreal forest and coastal rainforest are slowly encroaching from the east on the area of this province. This is explained by the assumption that the distribution of the vegetation is not yet adjusted to the climatic conditions produced by retreat of the last continental glaciers.

Soils.--About 30 percent of the area consists of high mountains without soil cover. Dominant soils are Inceptisols formed from volcanic ash or pumice, with large components of pyroclastic materials. Permafrost is generally absent.

Fauna.--The Aleutian Islands support no land mammals larger than foxes. Marine mammals such as seals, sea lions, and sea otters are abundant, using the islands for hauling out and as rookeries.

Bald eagles and hawks are prevalent predators, feeding on the millions of sea birds that use the islands and rocks as rookeries.

Marine Division

Situated on the Pacific coast between latitudes 40 and 60 N. is a zone that receives abundant rainfall from maritime polar air masses and has a rather narrow range of temperatures because it borders on the ocean. The average temperature of the warmest month is below 72F (22C), but at least four months per year have an average temperature of 50F (10C). The average temperature during the coldest month of the year is above 32F (0C).

Precipitation is abundant throughout the year, but is markedly reduced during summer. Although total rainfall is not great by tropical standards, the cooler air temperatures here reduce evaporation and produce a very damp, humid climate with much cloud cover. Mild winters and relatively cool summers are typical. Coastal mountain ranges influence precipitation markedly in these middle latitudes. The mountainous coasts of British Columbia and Alaska annually receive 60 to 80 inches (1,530 to 2,040 mm) of precipitation and more. Heavy precipitation greatly contributed to the development of fiords along the coast: heavy snows during the glacial period fed vigorous valley glaciers that descended to the sea, scouring deep troughs that reach at their lower ends below sea level.

Natural vegetation in the Marine Division is needleleaf forest. In the coastal ranges of the Pacific Northwest, Douglas-fir, redcedar, and spruce grow to magnificent heights, forming some of the densest of all coniferous forests with some of the world's largest trees.

The Marine Division is dominated by evergreen and, to a lesser extent, deciduous forests located along the Pacific Coast. Temperate forests are among the most productive habitats in the world and, due to routine subjection to disturbances that increase variability in the environment, they provide habitat for a diversity of wildlife, including mule deer, bobcat, mountain lion, black bear and grey fox.

In general evergreen trees support less wildlife than deciduous, as they are less palatable. Conifers do possess characteristics that are critical to the survival of many wildlife species, providing critical winter cover for elk, deer and Spruce grouse. Grey squirrels are common among the oak trees of deciduous groves.

Since this ecoregion is characterized by abundant rainfall, there is an abundance of moisture on the forest floor, as well as in ponds and streams, to support a diversity of amphibians. All frogs and toads in this region lay their eggs in water. Most salamanders lay their eggs in or near water, while others lay their eggs on land under logs, in rock outcrops, or both. Many of these amphibians spend a portion or most of their lives out of water, living under moist logs, dead wood, or forest litter, or in burrows or root or rock crevasses.

Few reptiles are found in this ecoregion. The alligator lizard is the only widely distributed species found in forested habitats, and the painted turtle and western pond turtle are the only turtles common in the area. The most common snake is the northwestern garter snake.

Birds have adapted to exploit the different layers of vegetation in the forest. Cavities in snags provide shelter and nesting sites for woodpeckers, owls, and other cavity-using wildlife, while dead and dying bark often harbors large numbers of insect prey for birds. Ruffed grouse, winter wren, American robin, spotted towhee, and dark-eyed junco are often found near the forest floor or in shrubs. Woodpeckers and brown creepers are seen moving up and down the trunks of trees in search of insects. Nuthatches and chickadees exploit the cone seeds, while warblers and kinglets glean insects from the upper deciduous forest canopy. Shrews, mice and moles are fossorial and also exploit the vegetation types and strata of the forest, while rabbits and hares see shelter in dense vegetation near forest edges

A number of species rely on old-growth forests for most or all of their life requisites. Old-growth forests in the Marine Ecoregion generally consist of conifer trees with a diameter of more than 3 feet at the base of the tree, and that are more than 200 years old. These forests also contain a multilayered canopy and numerous snags and logs. Vaux's swifts depend on large, hollow snags for nesting and roosting habitat. Marbled murrelets use the stout branches of old-growth trees for nest platforms. Northern spotted owl nest in tree cavities and feed on northern flying squirrels. Banana slugs, Pacific giant salamander, Olympic salamander, and Oregon slender salamander are other species that prefer the rotting logs and moist soil conditions found in old-growth habitats.

Soils are strongly leached, acid Inceptisols and Ultisols. Due to the region's cool temperatures, bacterial activity is slower than in the warm tropics, so vegetative matter is not consumed and forms a heavy surface deposit. Organic acids from decomposing vegetation react with soil compounds, removing such bases as calcium, sodium, and potassium.

Pacific Lowland Mixed Forest Province

Land-surface form.--The Pacific Lowland Mixed Forest occupies a north-south depression between the Coast Ranges and the Cascade Mountains. Elevations range from sea level to 1,500 feet (460 m). The Willamette Valley has nearly level to gently sloping floodplains bordered by dissected high terraces and hills. The Puget Sound Valley is a moderately dissected tableland covered by glacial till, glacial outwash, and lacustrine deposits. This province includes isolated hills and low mountains.

Climate.--Because this province is close to the Pacific Ocean, its climate is generally mild throughout the year. Annual temperatures average 48 to 55F (9 to 13C). The moderate rainfall reaches its maximum in winter; summer has a slight moisture deficit. Average annual rainfall ranges from 15 to 60 inches (380 to 1,530 mm); but in much of the area, the range is from 30 to 45 inches (760 to 1,150 mm). Coastal mountains are responsible for the drier and less muted climate. Fog partially compensates for the summer drought.

Vegetation.--Before cultivation, dense coniferous forest dominated the vegetation here. Principal trees are western redcedar, western hemlock, and Douglas-fir. In interior valleys, the coniferous forest is less dense than along the coast and often contains deciduous trees, such as big-leaf maple, Oregon ash, and black cottonwood. There are prairies that support open stands of oaks or are broken by groves of Douglas-fir and other trees; principal indicator species are Oregon white oak and Pacific madrone. Poorly drained sites with swamp or bog communities are abundant.

Soils.--Alfisols, Inceptisols, and Ultisols are the principal soil orders. Inceptisols dominate in Puget Sound Valley.

Fauna.--The fauna are closely related to those of the surrounding Cascade Province (described below). Mule deer is the most common large mammal. Chief mammalian predators are the mountain lion and bobcat. The western gray squirrel lives in oak trees, and the bushytail wood rat builds nests on shrub-covered stream margins and at forest edges. Isolated thickets are inhabited by brush rabbit and gray fox. Ruffed grouse inhabit the same scattered thickets. The dusky Canada goose winters exclusively in the Willamette Valley in Oregon. The periodically abundant acorn crop attracts flocks of band-tailed pigeons, acorn woodpeckers, and mountain quail. The dry terrain is ideal for reptiles, including the northern Pacific rattlesnake, the only poisonous snake in the Pacific Northwest.

Cascade Mixed Forest--Coniferous Forest--Alpine Meadow Province

Land-surface form.--The Cascade Province covers a series of steep, rugged mountains bordered in places by a narrow coastal plain. Mountains along the coast rise 5,000 feet (1,500 m) above sea level, with a local relief of 1,000-3,000 feet (300-900 m). The interior Cascade Range has mountains 8,000-9,000 feet (2,400-2,700 m) in altitude, dominated every 5-85 miles (8-135 km) by a volcano of much higher elevation. Mt. Rainier, for example, rises more than 14,000 feet (4,300 m) above sea level. Some parts of the province, especially its northern portion and the Cascade Range, have been glaciated.

Climate.--Because this province borders on the Pacific Ocean, its climate is characterized by generally mild temperatures averaging 35 to 50F (2 to 10C) throughout the year. Rainfall is heavy, 30 to 150 inches (770 to 3,800 mm) per year, with a maximum in winter. Humidity is always high, producing an extremely favorable precipitation/evaporation ratio. The southern part of this province is winter-wet with no snow; fog partially compensates for the summer drought. As one moves to the north, the summer dry season shortens, and the proportion of precipitation falling as snow increases. On high mountains, all precipitation may be snow, which reaches depths of 50 to 65 feet (15 to 20 m). East slopes are much drier than west slopes, accumulating less than 20 inches (511 mm) of precipitation per year.

Vegetation.--The Cascade Province is primarily montane, but it ranges from sea level to altitudes above 5,000 feet (1,500 m). At the lowest elevations, there is a dense conifer forest of Douglas-fir, western redcedar, western hemlock, grand fir, silver fir, Sitka spruce, and Alaska-cedar. Numerous species of shrubs grow exceptionally well in this forest and around its margins. In many places, this vegetation is practically impenetrable.

Although Douglas-fir is the most abundant tree at lower elevations in the region, it is not part of the climax forest. Western hemlock and several other species of fir are more tolerant of shade than Douglas-fir, and in mature forest stands, Douglas-fir cannot regenerate. On the western and southern slopes of the Olympic Mountains in Washington, hemlock is eventually displaced by the more shade-tolerant silver fir.

In the humid conifer forests of southwestern Oregon, Alaska-cedar is replaced by silver fir and redwood. In the fog belt along the coast of northwestern California, redwood is the characteristic tree. Douglas-fir and other conifers associate with it to form perhaps the densest of all coniferous forests, with the world's largest trees. Some redwoods attain heights of more than 325 feet (99 m) and girths of more than 65 feet (19.8 m).

A xerophytic forest of ponderosa pine grows along the dry eastern slopes of the Cascades, descending to 500 feet (150 m) along the eastern foot of the range at the Columbia River. This is typically open forest mixed with grass and shrubs. It occurs throughout the Southwest, the Sierra Nevada, the Rocky Mountains, and the Black Hills.

The high, snowcapped mountains of the Cascades have a well-marked subalpine forest belt that reaches into British Columbia. Important trees are mountain hemlock, subalpine fir, whitebark pine, and Alaska-cedar. To the north, the subalpine forest becomes fragmentary or disappears completely.

All but the highest peaks are covered by forest. In the Cascade Mountains of Oregon, timberline varies from 7,700 to 10,000 feet (2,350 to 3,050 m). Above timberline, there is an alpine zone with rich communities of shrubs and herbs. Perpetual snow is confined to small patches.

Riparian forests in the Pacific Northwest are an exception to the general rule that conifers dominate in the region. Along the region's many rivers and streams, needleleaf trees are replaced by broadleaf species such as black cottonwood and red alder. This kind of forest occurs from southern Alaska south through Washington, Oregon, Idaho, and western Montana, continuing into northern California and the Sierra Nevada.

Soils.--Andisols are extensive where underlain by volcanic ash. Moist Inceptisols are found west of the Cascades; dry soils predominate in the rain shadow east of the mountains.

Fauna.--Common large mammals include elk, deer, mountain lion, bobcat, and black bear. Small mammals include mice, Douglas squirrels, martens, Townsend chipmunks, red tree voles, and bushytail wood rats.

The more common birds are the winter wren, Townsend's warbler, chestnut-backed chickadee, red-breasted nuthatch, gray jay, and Steller's jay. The most important game birds are blue and ruffed grouse; there are hawks and owls in the northwestern part of the province. Spotted owl and marbled murrelet depend on remaining old-growth forests.

Among the many species of amphibians that live in this region's moist, cool forests are the Pacific treefrog and the Pacific giant salamander. Reptiles include the northern alligator lizard and rubber boa.

The many swift-flowing rivers of the region are high in dissolved oxygen and generally unpolluted, making them ideal habitats for various salmon and trout species.

Pacific Coastal Icefields

Land-surface form.--The Coast Mountains rise precipitously from the sea to altitudes of about 9,000 feet (2,700 m), cut by an intricate network of deep, narrow fiords. Farther north, in the rugged St. Elias, Chugach, and Kenai Mountains, elevations range from sea level to more than 16,000 feet (4,900 m). Mount Logan (19,850 feet [6,050 m]) and Mount St. Elias (18,008 feet [5,490 m]) are the second and forth highest peaks on the continent of North America. Icefields and glaciers cover the higher parts of the mountains, forming some of the most extensive valley glacier systems in North America.

Climate.--The marine climate is the same as in Oregon and Washington, except that it has cool summers. Less than four months each year have average temperatures higher than 50F (10C). Despite the many glaciers, the climate is surprisingly mild, with average winter temperatures of about 32F (0C) and minimum temperatures of 0F (18C). Summer temperatures average in the 50's (10-15C), with highs in the 90's (32-37C). The growing season lasts four months or more. Precipitation is heavy, generally averaging more than 80 inches (2,040 mm) annually, with some places getting more than 150 inches (3,830 mm). Inland, the climate grows increasingly severe, partly because of rising distance from the ocean, but chiefly due to higher altitude. Topography and high precipitation form so much ice in the mountains that glaciers extend down to sea level despite mild temperatures. Above 3,000 feet (900 m), there is perennial ice, and above 8,000 feet (2,400 m), even summer storms are usually accompanied by snow.

Vegetation.--The most important trees in the thick forest that covers the lower elevations of this province are Alaska-cedar, western hemlock, mountain hemlock, Sitka spruce, several species of willow, and black cottonwood. Several kinds of shrubs also grow in the forest, often forming a fringe on its margins. In many places, the dense vegetation is practically impenetrable.

The timberline is at low elevations, and much of the mountainous area above it is covered with nearly bare rocks, snowfields, and glaciers. Wherever soil has accumulated, however, there are grasses, herbs, and low shrubs. The timberline varies greatly in elevation from place to place, depending on slope exposure and other factors. Near Prince William Sound, for example, the timberline is usually between 1,000 and 2,000 feet (300 and 600 m), but sometimes it drops as low as 500 feet (150 m).

Soils.--Icefields and bare rock or rubble make up about 70 percent of the area. The dominant soils are cool, moist Inceptisols.

Fauna.--Due to the glacial character of the region, Sitka deer do not range into the area, nor do many of the large animals of the interior. The only important large mammals are brown and black bears and mountain goats. The principal small mammals are red squirrels, voles, and shrews. Birds include some arctic types of water birds, such as murrelets and puffins. Land birds include sooty grouse, white-tailed ptarmigan, and Steller's jay. There are no reptiles or amphibians.

Pacific Gulf Coastal Forest Province

Land-surface form.--The Alexander Archipelago, with its hundreds of islands formed by the partly submerged western foothills of the Coast Range, makes up most of this province. The larger islands have mountains 3,000-5,000 feet (900-1,500 m) high, with slopes covered by dense forest where they are not too steep. Long, narrow bays carved into the mountains by glaciers create extremely irregular coastlines. Northward, at Prince William Sound and Kodiak Island, the foothills are mixed with coastal lowlands consisting of alluvial fans, uplifted estuaries, morainal deposits, dunes, and river deltas and terraces.

Climate.--Though similar to that of the Pacific Coastal Mountains Province, the climate here is milder due to the region's generally lower elevation. At Sitka, Alaska, average monthly temperatures for January and August are approximately 28F and 50F (2C and 10C), respectively, for an annual temperature range of only 22F (8C). Precipitation, which averages 96 inches (2,450 mm) per year, reaches a maximum in autumn.

Vegetation.--A coastal rainforest of Sitka spruce and western hemlock provides the dominant vegetation. In poorly drained areas, a wetland vegetation of sphagnum moss, sedges, and willows fosters peatland development. Alder, cottonwood, and birch are found in low-lying areas and along major river channels.

Soils.--The dominant soils are Spodosols.

Fauna.--A characteristic large mammal is the Sitka black-tailed deer. Other mammals include the brown bear, black bear, wolf, red squirrel, and moose. The mountain goat is common on mainland mountain heights, but not on the islands. Sea otters and Steller's sea lions are common throughout Prince William Sound.

A conspicuous and characteristic bird is the Alaska bald eagle. A small sea bird, the marbled murrelet, nests in the tall trees of old-growth forests. Water birds are well represented, including loons and ducks, and there are many gulls and other shore birds. Common land birds include the red-breasted sapsucker, Pacific-slope flycatcher, and golden-crowned kinglet, and both the red and white-winged crossbills. The entire population of dusky Canada geese nests within this province. Fish are abundant in the waters, including several species of salmon.

Mediterranean Division

Situated on the Pacific coast between latitudes 30 and 45 N. is a zone subject to alternate wet and dry seasons, the transition zone between the dry west coast desert and the wet west coast.

The division has a temperate rainy climate with the dry, hot summers. The combination of wet winters with dry summers is unique among climate types and produces a distinctive natural vegetation of hardleaved evergreen trees and shrubs called sclerophyll forest. Various forms of sclerophyll woodland and scrub are also typical. Trees and shrubs must withstand the severe summer drought--two to four rainless months--and severe evaporation.

The vegetation of the Mediterranean Ecoregion is dominated by grassland, shrubland, and forestland habitats. Many shrub (chaparral) and forest/woodland plant species have thick, hard, evergreen leaves. The number of wildlife species using shrub habitats is limited by the lack of trees in shrublands. However, wildlife species diversity can also be limited in evergreen woodlands due to the paucity of shrubs in these communities, as shrubs are often unable to compete with trees for the limited moisture.

Because of their tough, leathery texture, the leaves of vegetation in chaparral communities are resistant to wilting, and thus provide cover for wildlife even during the frequent droughts typical of the region. Wildlife found in chaparral tend to be species that nest on the ground or in shrubs, such as ground- and shrub-nesting birds and rodents, or that prey upon ground- and shrub-dwelling species, including coyote, striped skunk, and bobcat.

Although this ecoregion supports a diverse vertebrate fauna, including numerous species of reptiles and rodents, only a limited number of species are closely tied to the chaparral. These include the mountain quail, California thrasher, wrentit, brush rabbit, California mouse, and dusky-footed woodrat.

Mountain quail favor slopes covered with chaparral. They feed on acorn mast, fruits, and seeds in the fall, leafy foods during winter, and bulbs in the spring and summer. Thrashers and wrentits find good food and cover in the chaparral, and are more often seen than heard in the dense vegetation. The brush rabbit does not use burrows regularly like most other species of rabbits, perhaps because of the dense chaparral cover. Woodrats construct stick dens that are also used by the California mouse. Since homes are constructed of sticks, woodrats are vulnerable to fires in chaparral communities.

Chaparral communities are adapted to fire, and wildlife respond by retreating to burrows, hiding in rock crevices, or escaping from the area. After a fire, seed-eating birds, such as mourning doves, move into the area to feed on seeds exposed by fire. Mule deer seek out the temporary community of herbaceous plants that develop during the first year or two after the fire. Many of these plants produce bright flowers that attract nectar-feeding insects and birds.

Deciduous and evergreen woodlands provide vegetation structure and complexity that benefits a variety of wildlife species. The habitat often occurs in a mosaic-like pattern of conifer stands intermixed with deciduous tree stands. The shrub and herbaceous strata are often poorly developed in these woodlands. Mature woodlands are important to cavity nesting birds, and oak mast crops are an important food source for birds and mammals, such as scrub and Steller's jays, acorn woodpecker, wild turkey, mountain quail, California ground squirrel, western gray squirrel, black bear, and mule deer. Amphibians that reside in the forest detritus layers include Mount Lyell salamander, ensatina, and relictual slender salamander.

Oak woodlands serve as important wildlife habitat, supporting over 300 vertebrate species, many of which are special status species such as the California spotted owl and willow flycatcher. Oak trees provide nesting sites for both canopy- and cavity-nesting birds, and the acorns they produce are an autumn food source relied upon by many bird and mammal species.

Annual and perennial grasslands are found in central and coastal California. Annual grassland habitats consist largely of non-native annuals that have displaced native perennials. Habitat structure and wildlife abundance are dependent on a mix of plant species at a site. Sites with western brackenfern exhibit a taller, more diverse structure than sites with shorter grasses. Many wildlife species use grassland habitats, but some require special habitat features, such as cliffs, caves, ponds, or shrubby areas for breeding, resting, and escape cover.

Soils of this Mediterranean climate are not susceptible to simple classification. Alfisols and Mollisols typical of semiarid climates are generally found.

California Coastal Chaparral Forest Shrub Province

Land-surface form.--This province includes the discontinuous coastal plains, low mountains, and interior valleys adjacent to the Pacific Ocean from San Francisco to San Diego. Elevations range from sea level to 2,400 feet (730 m).

Climate.--The climate is characterized by hot, dry summers and rainy, mild winters. Annual temperatures average 50 to 65F (10 to 18C). Annual precipitation ranges from 10 to 50 inches (260 to 1,280 mm), with a pronounced summer drought. This coastal province has a more moderate climate than the interior and receives some moisture from fog in summer. Fire is common, usually set by lightning during the summer dry season.

Vegetation.--Plant communities are well marked in this province. Several tree species are endemic to the region, including the Monterey cypress, Torrey pine, Monterey pine, and Bishop pine. The coastal plains and larger valleys have sagebrush and grassland communities. A riparian forest containing many broadleaf species grows along streams. On the hills and lower mountains, there is sclerophyll forest consisting of low trees with small, leathery leaves that can withstand the lack of summer precipitation. Live oak or white oak woodland is found here. On steep hill and mountain slopes too dry to support oak woodland or oak forest, much of the vegetation is scrub or "dwarf forest" known as chaparral, which varies in composition with elevation and exposure. It consists of chamise and various manzanitas that are adapted to periodic occurrence of fire. Exposed coastal areas support desertlike shrub communities called coastal scrub, dominated by coyote bush, California sagebrush, and bush lupine. Toward southern California, sages become abundant within coastal scrub communities.

Most of the coastal plains and interior valleys have been converted to urban use or irrigated agriculture. Citrus, grapes, avocados, nuts (such as almonds and walnuts), and deciduous fruits are grown extensively. Irrigated alluvial soils are also highly productive of vegetable crops. Bluegum eucalyptus and other species imported from Australia are abundant along roadsides and much of the coastline as well as farther inland.

Soils.--The soils of this region are mostly Alfisols and Mollisols. They are high in bases and quite fertile when soil water is adequate.

Fauna.--The brushy rabbit is common, as is the opossum, North America's only marsupial. Several species of seals and sea lions live along the California coast, and sea otters often float among kelp, feeding on sea urchins. The blue whale, the world's largest animal species, is found in California's coastal waters.

Coastal California is a major migration route for both water and land birds. From midsummer through winter and spring, thousands of shore birds, ducks, and geese inhabit coastal estuaries, lagoons, and mudflats. Other birds include the lesser goldfinch and golden-crowned sparrow.

California Dry Steppe Province

Land-surface form.--This province lies within the Central Valley of California--a flat alluvial plain between the Sierra Nevada and the Coast Ranges. Elevations range from sea level to 500 feet (150 m). This area has broad, nearly level valleys bordered by sloping alluvial fans, slightly dissected terraces and the lower foothills of the surrounding uplands. Large undrained basins lie in the south.

Climate.--Annual temperatures in this climate average 60 to 67F (16 to 19C), but can fall as low as 55F (13C) in the south. Precipitation is largely limited to winter rainfall, which peaks in December, January, and February. Except near the coast, summers are hot and the winters mild--often foggy, with little or no snow. Annual rainfall ranges from approximately six inches (150 mm) in the upper San Joaquin Valley to nearly 30 inches (760 mm) along the coast. Potential evaporation during the warmest months is often much greater than the precipitation. Low rainfall and small streamflow result in water scarcity in many areas.

Vegetation.--Evidence indicates that the Central Valley of California was once dominated by natural grasses that the plow, fire, and grazing have eliminated except in a few remaining stands. These stands suggest that the dominants were bunch grasses on lands similar in appearance to mixed prairie. Apparently, needlegrass was the principal species except near the coast. Today, introduced annual grasses, including various species of avens, brome, fescue, and barley, occupy most of the remaining grassland areas.

The rivers flow through alkaline flats where greasewood, picklewood, salt grass, and shadscale provide the chief cover. Tule marshes border the lower reaches of the San Joaquin and Sacramento Rivers.

Soils.--The soils of this region are mostly Entisols and Alfisols. The Entisols are usually at the lower elevations and the Alfisols at slightly higher elevations, away from the valley floor. A small area of Aridisols occurs in the more arid southern portions of the San Joaquin Valley.

Fauna.--Intensive agricultural development has changed the fauna of the annual grasslands. Larger species, such as the California grizzly bear, wolf, and pronghorn antelope, have been eliminated or pushed up into the hills. Common mammals include the Beechy ground squirrel, cottontail, blacktail jackrabbit, California mouse, and kangaroo rats. Several subspecies of mule deer live in brushy areas. Other species, such as the coyote and bobcat, live in adjacent woodlands, occasionally entering from them. The San Joaquin kit fox is classified as an endangered species.

Common birds include the mourning dove, horned lark, western meadowlark, western kingbird, mockingbird, loggerhead shrike, house finch, lesser goldfinch, red-shafted flicker, and scrub jay. The roadrunner feeds on reptiles and insects.

The California quail is numerous in areas where brush or rock outcrops provide cover. Avian predators include the golden eagle, red-tailed hawk, and Cooper's hawk.

Several species of snakes and lizards are present; rattlesnakes are important predators on rodents.

California Coastal Steppe, Mixed Forest, and Redwood Forest Province

Land-surface form.--Much of this province is composed of low mountains, but in places there is a narrow coastal plain and gently sloping marine terraces. A few broad valleys extend inland through the mountains. Confined to the coast, this region extends no farther inland than 35 miles (56 km), remaining at elevations below 3,000 feet (900 m).

Climate.--Characterized by a cool-summer subtype of the Mediterranean dry-summer subtropical climate, this province is confined to coasts washed by cool currents. The annual temperature cycle is very weak, reflecting the powerful influence of the cold California sea current with its cool marine air layer. Cool summers are typical, and winter temperatures are much milder than those of inland locations at similar latitudes. Annual temperatures average 50 to 55F (10 to 13C). All months are above freezing. Rainfall drops to nearly zero for two consecutive summer months, but rises to substantial amounts in the rainy winter season. Annual rainfall ranges from 40 to 100 inches (1,020 to 2,550 mm). Heavy fogs are common along the coast in summer. This region has a greater mean number of days with dense fogs than any other place in the United States.

Vegetation.--The redwood is characteristic of the fog belt on seaward slopes of coastal northwestern California. Associated with it are Douglas-fir and other conifers such as hemlock and cedar. The redwood forest is a hygrophyllic type of warm-temperate forest. Redwoods, which attain a height of 330 feet (100 m), are taller than the giant sequoia (big tree), which grows only in the Sierra Nevada of California. But redwood trunks remain relatively slender. Although redwoods live 500 years on average, they can reach up to 1,800 years of age. By comparison, 4,000 annual rings have been counted in the trunks of giant sequoia.

Redwood forests typically have a well-developed understory, usually dominated by large and colorful Pacific rhododendrons and western azaleas. Other shrubs, especially salal and California huckleberry, are usually present. Many ferns and flowers grow in the cool shade, such as western sword fern and redwood sorrel.

Headlands tend to be dry, and their outer ends are covered with fescue-oatgrass grasslands. Along the coast in a narrow, patchy belt lies pine-cypress forest. Inland, the southfacing mountain slopes are covered by mixed forest, including tanoak, coast live oak, madrone, and Douglas-fir. Oaks in the area of coastal forest tend to form distinct patches of oak woodland.

Soils.--The dominant soils are Ultisols under forest and Mollisols under grasslands.

Fauna.--Mule deer are common, and the Roosevelt subspecies of elk can be seen in Redwood National Park. Mammals include both Douglas and western gray squirrels, as well as two chipmunk species.

Birds include Anna's hummingbird and Wilson's warbler. The spotted owl can be found in both old-growth and second-growth redwood forest, along with great horned owls, western screech-owls, and northern pygmy-owls. A variety of shore birds and waterfowl occur in the coastal part of the province. Species of concern include marbled murrelet and northern spotted owl.

Salamanders, such as the Pacific giant salamander, are numerous in the cool, moist litter of the redwoods, especially near streams and rivers. The banana slug is also found here. Streams and rivers are used by anadromous fish.

Sierran Steppe--Mixed Forest--Coniferous Forest--Alpine Meadow Province

Land-surface form.--This province covers the southernmost portion of the Cascade Mountains, the northern Coast Range, the Klamath Mountains, and the Sierra Nevada. Most of the area is covered with steeply sloping to precipitous mountains crossed by many valleys with steep gradients. The long west slope of the Sierra Nevada rises gradually from 2,000 feet (600 m) to more than 14,000 feet (4,300 m); the east slope drops abruptly to the floor of the Great Basin, about 4,000 feet (1,200 m). Much of this region has been glaciated.

Climate.--Temperatures average 35 to 52F (2 to 11C), but fall with rising elevation. The base of the west slope receives only about 10 to 15 inches (250 to 380 mm) of rainfall per year and has a long, unbroken dry summer season. At higher elevations, the dry summer season shortens and precipitation rises to as much as 70 inches (1,790 mm), with a larger portion falling as snow. Prevailing west winds influence climatic conditions for the whole region. East slopes are much drier than west slopes. Winter precipitation makes up 80 to 85 percent of the total; at high elevations, it is mostly snow. The greatest total precipitation reported is on slopes between 3,000 and 7,000 feet (900 and 2,100 m), which support the luxuriant mixed conifer forests of the montane zone. The subalpine zone coincides with the altitude of greatest snowfall, where precipitation is 40 to 50 inches (1,020 to 1,280 mm) per year.

Vegetation.--Vegetation zones are exceptionally well marked. The lower slopes and foothills, from about 1,500 to 4,000 feet (460 to 1,200 m), are covered by coniferous and shrub associations. On higher slopes, digger pine and blue oak dominate, forming typical open or woodland stands. Most of the low hills are covered by close-growing evergreen scrub, or chaparral, in which buckbrush and manzanita predominate. Several oaks are common associates.

The montane zone lies between about 2,000 and 6,000 feet (600 and 1,800 m) in the Cascades, 4,000 and 7,000 feet (1,200 and 2,100 m) in the Central Sierras, and 5,000 and 8,000 feet (1,500 and 2,400 m) or more in the south. The most important trees are ponderosa pine, Jeffrey pine, Douglas-fir, sugar pine, white fir, red fir, and incense cedar; but several other conifers are also present. The giant sequoia (big tree) is one of the most spectacular species, but it grows only in a few groves on the western slope. Dense chaparral communities of manzanita, buckbrush, and buckthorn may appear after fire, sometimes persisting for years. Within the Sierran rain shadow, on the dry eastern slopes, Jeffrey pine replaces ponderosa pine. At lower elevations, pine forests are replaced by sagebrush-pinyon forest, part of the Intermountain Desert Province.

The subalpine zone begins at from 6,500 to 9,500 feet (1,980 m to 2,900 m), depending on latitude and exposure, and extends upslope about 1,000 feet (300 m). Mountain hemlock, California red fir, lodgepole pine, western white pine, and whitebark pine are important. Conditions are severe, and timberline varies from about 7,000 feet (2,100 m) in the north to 10,000 feet (3,000 m) in the south. Lodgepole pine is said to have climax characteristics near the upper limits of this zone. The alpine zone covers the treeless areas above timberline.

Soils.--Ultisols are extensive on mountain slopes where air is humid; dry Alfisols predominate at lower elevations. Entisols occupy the narrow floodplains and alluvial fans of the valleys.

Fauna.--Common large mammals include mule deer, mountain lion, coyote, and black bear. Smaller mammals include golden-mantled squirrel, bushytail wood rat, flying squirrel, red fox, fisher, yellow-haired porcupine, long-eared chipmunk, and Trowbridge's shrew.

Common birds are mountain quail, Cassin's finch, Hammond's flycatcher, Lincoln's sparrow, Audubon's warbler, pine siskin, Oregon junco, blue goose, Williamson's sapsucker, and mountain chickadee. Birds of prey include the western screech-owl, Cooper's hawk, northern pygmy-owl, and great gray owl. The California mountain kingsnake also lives here. The bark beetles Ips emarginatus and I. integer infest ponderosa and lodgepole pine.

California Coastal Range Open Woodland--Shrub--Coniferous Forest--Meadow Province

Land-surface form.--This province occupies the central part of the California Coast Ranges and the mountains of southern California. The Coast Ranges are gently to steeply sloping low mountains underlain by shale, sandstone, and igneous and volcanic rocks. Elevations range from 500 to 2,500 feet (150 to 800 m); some peaks rise to 5,000 feet (1,500 m). Stream valleys are narrow and widely spaced. The mountains of southern California are steeply sloping to precipitous; high mountains have unstable slopes and sharp crests; valleys are narrow. Elevations range from 2,000 to 8,000 feet (600 to 2,400 m); some peaks reach 12,000 feet (3,700 m).

Climate.--The climate is characterized by hot, dry summers and rainy, mild winters. Temperatures average 53 to 65F (12 to 18C) in the Coast Range, but are only 32 to 60F (0 to 16C) in the mountains of southern California, always falling with rising elevation. Precipitation, which ranges from 12 to 40 inches (310 to 1,020 mm) per year, is evenly distributed through fall, winter, and spring, and increases with elevation. Most of this is rain; the little snow that falls in winter melts quickly. Frost and short periods of freezing weather occur occasionally in winter. Coastal areas have a more moderate climate than the interior and receive some moisture from fog in summer.

Vegetation.--The montane vegetation of this region consists of species with thick, hard evergreen leaves. One climax association, dominated by trees, is called sclerophyll forest. The other, called chaparral, is a shrub climax. These two associations appear in alternating patches in almost every part of the region, but chaparral occupies the greater area. The forest consistently appears on northfacing slopes and on wetter sites; chaparral occupies southfacing slopes and drier sites.

The most important evergreen trees of the sclerophyll forest are California live oak, canyon live oak, interior live oak, tanoak, California laurel, Pacific madrone, golden chinkapin, and Pacific bayberry. Several deciduous trees, shrubs, and herb associates are also characteristic.

The chaparral community of fire-adapted shrubs extends over a wide area with a diversity of habitats. It includes at least 40 species of evergreen shrubs with varying degrees of dominance and importance. Some are so dense that they practically eliminate understory vegetation; other types support a highly productive understory. The most important species are chamise and manzanita. Other common species are Christmasberry, California scrub oak, mountain mahogany, and many species of ceanothus. At higher elevations and near the ocean, chaparral is often interspersed with, or alternates with, coniferous forests.

The interior valleys have sagebrush and grassland communities. A riparian forest with many broadleaf species grows along streams.

Soils.--The pattern of Alfisols, Entisols, and Mollisols in this region is complex. Mollisols are usually found along the coast; Alfisols occur in the north; and the south consists mostly of Entisols.

Fauna.--Mule deer are the most important large mammals. Other large mammals include the coyote, mountain lion, California bobcat, gray fox, wood rat, and spotted and striped skunks. Small mammals peculiar to chaparral include the Merriam chipmunk, California mouse, and five-toed kangaroo rat.

The most common birds seen in the dry summer season are wrentit, common bushtit, and rufous-sided towhee. In October, white-and-golden-crowned sparrows, several races of fox sparrows, hermit thrushes, ruby-crowned kinglets, and Audubon's warblers are present. The California condor is classified as an endangered species.

Reptiles, including the coast horned lizard and gopher snake, are numerous in all vegetation types. Amphibians appear to be scarce, except for the Pacific treefrog.

DRY DOMAIN

Tropical/ Subtropical Steppe Division

Tropical steppes border the tropical deserts on both the north and south, and in places on the east as well. Locally because of altitude, plateaus and high plains within what would otherwise be desert have a semiarid steppe climate. Steppes on the poleward fringes of the tropical deserts grade into the Mediterranean climate in many places. In the United States, they are cut off from the Mediterranean climate by coastal mountains that allow tropical deserts to extend farther north.

The division has a hot semiarid climate where potential evaporation exceeds precipitation, and where all months have temperatures above 32F.

Steppes typically are grasslands of short grasses and other herbs, and with locally developed shrub- and woodland. On the Colorado Plateau, for example, there is pinyon-juniper woodland. To the east, in Texas, the grasslands grade into savanna woodland or semideserts composed of xerophytic shrubs and trees, and the climate becomes semiarid-subtropical. Cactus plants are present in some places. These areas are able to support limited grazing, but are not generally moist enough for crop cultivation without irrigation. Soils are commonly Mollisols and Aridisols, containing some humus.

The Temperate Steppe Ecoregion is comprised of prairie grasslands, evergreen and deciduous forests, and sagebrush and chaparral shrublands. Prairie grasslands occur in an environment with irregularities in weather patterns, including wet and dry spells, which occur often enough to impose severe stresses on wildlife. Drought years can cause rapid declines in some species, especially birds, as the abundance and quality of vegetation is markedly decreased.

Many grassland species live in burrows, including burrowing owls, prairie dogs, ground squirrels, pocket gophers, black-footed ferrets, and American badgers. Burrows provide a more stable microclimate during hot summers and cold winters, and shelter from predators and grassland fires. Animals that do not utilize burrows have adapted to speed in order to escape predators, including the swift fox and pronghorn. Even quail and grouse often run instead of flying to escape predation, staying close to the ground and using the vegetation as cover.

Grassland animals tend to occur in large social groups and tend to be more social than their forestland counterparts. Prairie dogs live in large, highly organized social units, while their eastern woodland counterpart, the woodchuck, rarely interacts with its own species. Flocking species are also more prevalent in grasslands than in forestlands. Socialization enables the members of a flock to more readily detect predators, but also to convey other information, such as mating status, which is difficult to ascertain in open grassland where sound is muffled and perches are few. Raptors are also more common in grasslands than other habitats, as open spaces favor animals with good vision and provide an abundance of prey items.

Compared with other habitats, grasslands tend to have low bird species diversity and abundance as they are structurally simple and less complex than other habitat types, and thus provide birds with few niches to exploit. Bird species tend to differentiate themselves based on the cover and height of the grassland vegetation, with the horned lark and burrowing owl selecting areas with low, scattered vegetation, and the savanna sparrow and bobolink selecting high, dense herbaceous cover.

Deer, elk, and pronghorn are found in the intermountain grasslands, which can not support Temperate Steppe species that require a supply of green grass year-round. Ground squirrel diversity is especially high in the intermountain grasslands, with 19 of the 22 species of ground squirrels in North America found in this region.

Evergreen and deciduous forests are found at higher elevations and along streams and other aquatic areas. Aspen is an important component of these forests. American beaver use aspen limbs and foliage for food and to build dams and lodges. Snowshoe hare feed on aspen twigs and bark during winter, and aspen buds are important in the winter diet of ruffed grouse. American badger, ground squirrels, and other burrowing animals are common in this habitat.

Colorado Plateau Semidesert Province

Land-surface form.--The Colorado Plateau Province consists of tablelands with moderate to considerable relief in Arizona, New Mexico, and Utah. Elevations of the plateau tops range from 5,000 to 7,000 feet (1,500 to 2,100 m), with local relief ranging from 500 to more than 3,000 feet (150 to 900 m) in some of the deeper canyons that dissect the plateaus (such as the Grand

Canyon of the Colorado River). In some areas, volcanic mountains rise 1,000 to 3,000 feet (300 to 900 m) above the plateau surface. Stream valleys are narrow and widely spaced. The Colorado River, which crosses the northern part of the province, is the region's only large stream. Many other streams flow year-round, but the volume of water fluctuates considerably.

Climate.--Due to the region's generally high altitude, the climate is characterized by cold winters. Summer days are usually hot, but nights are cool; accordingly, the diurnal variation in temperature is considerable. Annual average temperatures are 40 to 55F (4 to 13C), decreasing with rising elevation. Average annual precipitation is about 20 inches (510 mm), except on the higher mountains; some parts of the province receive less than 10 inches (260 mm). Summer rains are thunderstorms, with ordinary rains arriving in winter. Thus, this province differs from the Intermountain Semidesert Province, which generally lacks summer rains.

Vegetation.--Vegetational zones are conspicuous but lack uniformity. In the lowest zone, there are arid grasslands, but the shortgrass sod seldom covers the ground completely, leaving many bare areas. Xeric shrubs often grow in open stands among the grasses, and sagebrush is dominant over extensive areas. A profusion of annuals and perennials blooms during the summer rainy season. At low elevations in the south, several kinds of cactus and yucca are common. Cottonwoods and, more rarely, other trees grow along some of the permanent streams.

The woodland zone is the most extensive, dominated by open stands of two-needle pinyon pine and several species of juniper, often termed a pygmy forest. Between the trees the ground is sparsely covered by grama, other grasses, herbs, and various shrubs, such as big sagebrush and alderleaf cercocarpus.

The montane zone extends over considerable areas on the high plateaus and mountains, but it is much smaller in area than the pinyon-juniper zone. Vegetation in the montane zone varies considerably from area to area. In the south, especially in Arizona, ponderosa pine is the dominant forest tree. Douglas-fir is associated with ponderosa pine or else grows in more sheltered locations or at higher elevations. In Utah, by contrast, lodgepole pine and aspen are dominant.

The subalpine zone is characterized by abundance of Engelmann spruce and subalpine fir. On San Francisco Mountain in northern Arizona, the spruce is often associated with bristlecone pine. Because only a few isolated mountains rise above timberline, the alpine zone is not extensive.

South of the Mogollon Rim in Arizona, toward the American Desert, lies a foothill forest. The principal trees are Mexican pinyon, alligator juniper, and various species of oak. Forests of ponderosa pine and common Douglas-fir carpet moist canyons and northfacing slopes. Pointleaf manzanita is a common evergreen shrub.

Soils.--Entisols occur along the floodplains of major streams. Aridisols cover plateau tops, older terraces, and alluvial fans. Badlands of rough broken land are extensive in the mountains and on plateaus.

Fauna.--Major mammals are the mule deer, mountain lion, coyote, and bobcat; elk are locally important. Pronghorn antelope are the primary large mammal in the arid grasslands. Smaller species include the blacktail jackrabbit, Colorado chipmunk, rock squirrel, wood rat, white-footed mouse, cliff chipmunk, cottontail, porcupine, and gray fox. The ringtail cat and spotted skunk occur rarely.

The most abundant resident birds are the bushtit, pinyon jay, plain titmouse, black-chinned hummingbird, Woodhouse's jay, red-tailed hawk, golden eagle, red-shafted flicker, and rock wren. Summer residents include the chipping sparrow, nighthawk, black-throated gray warbler, northern cliff swallow, lark sparrow, and mourning dove. Common winter residents are the pink-sided junco, Shufeldt's junco, gray-headed junco, red-backed junco, Rocky Mountain nuthatch, mountain bluebird, robin, and Steller's jay. Turkeys are locally abundant during winter. Reptiles include the horned lizard, collared lizard, and rattlesnake.

Southwest Plateau and Plains Dry Steppe and Shrub Province

Land-surface form.--This is a region of flat to rolling plains and plateaus occasionally dissected by canyons at the western end of the Gulf Coastal Plain and the southern end of the Great Plains. The Stake Plains of Texas are included in this province. Elevations range from sea level to 3,600 feet (1,100 m) on the Edwards Plateau and to 6,500 feet (1,980 m) near the Rocky Mountain Piedmont. A mesa-and-butte landscape is characteristic of certain parts.

Climate.--The climate is semiarid. Summers are long and hot, and winters are short and mild. Annual temperatures average 60 to 70F (16 to 21C). The frost-free season ranges from about 130 to considerably more than 300 days. Precipitation, which falls mostly during the growing season, is about 30 inches (770 mm) in the eastern part of the province and decreases to 10 to 15 inches (255 to 380 mm) in the western part. Annual evaporation is 71 to 79 inches (1,800 to 2,000 mm). From May to October, potential evaporation is about twice the precipitation.

Vegetation.--This province is characterized by arid grasslands in which shrubs and low trees grow singly or in bunches. On the plains of northwestern Texas and eastern New Mexico, xerophytic grasses (blue grama and buffalo grass) are the characteristic vegetation. However, in much of this area, mesquite (Prosopis) grows in open stands among the grasses. On the Edwards Plateau, oak and juniper are often mixed with grasses and mesquite, and on steep rocky slopes these trees may form closed stands. Due to low rainfall, they rarely grow higher than 20 feet (6.1 m). The most characteristic tree is Ashe juniper. Over much of the Plateau, the characteristic vegetation is grass, especially prairie three-awn (needlegrass); trees and shrubs are present only in very open stands. On slopes leading down to the Rio Grande, the ceniza shrub dominates. Live oak forest is found along the Gulf Coast. A unique semiarid forest consisting of small trees and shrubs with Mexican affinities occupies the Rio Grande delta. The endangered sabal palm is native here.

Soils.--Soils in this region are varied, but the different orders are well correlated with the different plant communities. The mesquite-live oak savanna, for example, is the only Entisol area in the region. Soils of the mesquite-buffalograss and juniper-oak savannas are almost entirely Mollisols; an island of Alfisols within the area corresponds to the boundaries of the mesquite-oak savanna. In the mesquite-acacia savanna, Mollisols, Alfisols, and Vertisols occur. On sandy soils in the Staked Plains of Texas, a thick growth of low shin oak practically excludes every other type of plant.

Fauna.--The northern limit of distribution of several mammals coincides generally with the northern boundary of this province. The Mexican ground squirrel and gray fox live to the south of this boundary, but not to the north. Whitetail deer are abundant, and armadillo are present. The fox squirrel is hunted in wooded areas along streams. Chief furbearers are the ringtail and raccoon. The Edwards Plateau contains several scattered limestone caverns that support huge populations of Mexican freetail bats.

The threatened golden-cheeked warbler and black-capped vireo inhabit northwestern areas where the Ashe juniper is present. Wild turkey, mourning dove, scaled quail, and bobwhite are common game birds, and several species of hawks and owls are present.

Arizona-New Mexico Mountains Semidesert--Open Woodland--Coniferous Forest--Alpine Meadow Province

Land-surface form.--This area consists mostly of steep foothills and mountains, but includes some deeply dissected high plateaus. Elevations range from 4,500 to 10,000 feet (1,370 to 3,000 m), with some mountain peaks reaching as high as 12,600 feet (3,840 m). In many areas, the relief is higher than 3,000 feet (900 m). Isolated volcanic peaks rise to considerable heights in the northwest.

Climate.--Climate varies considerably with altitude. Average annual temperature is about 55F (13C) in the lower foothills and 40F (4C) on the upper mountain slopes. Average annual precipitation ranges from 10 to 35 inches (260 to 890 mm), increasing with rising elevation. During late spring, there is a moisture deficit until the arrival of summer rains, which appear as thunderstorms. Rains also come in early autumn and winter. In the mountains, most precipitation is snow.

Vegetation.--Vegetational zones resemble those of the Rocky Mountains (described below), but occur at higher elevations. The foothill zone, which reaches as high as 7,000 feet (2,100 m), is characterized by mixed grasses, chaparral brush, oak-juniper woodland, and pinyon-juniper woodland. At about 7,000 feet (2,100 m), open forests of ponderosa pine are found, although pinyon and juniper occupy southfacing slopes. In Arizona, the pine forests of this zone are strongly infused with Mexican species, including Chihuahuan and Apache pine. Pine forest is replaced at about 8,000 feet (2,400 m) on northfacing slopes (a little higher elsewhere) by Douglas-fir. Aspen is common in this zone, and limber pine grows in places that are rockier and drier.

At about 9,000 feet (2,700 m), the Douglas-fir zone merges into a zone of Engelmann spruce and corkbark fir. Limber pines and bristlecone pines grow in the rockier places. An alpine belt covers relatively small areas above 11,000 feet (3,400 m).

Soils.--Detailed information about orders of soils is lacking for much of this area. The Four Corners region is composed mostly of Entisols. Alfisols and Inceptisols dominate upland areas. Stony land and rock outcrops occupy large areas on the mountains and in the foothills.

Fauna.--The most common large mammal is the mule deer. Mammalian predators include mountain lions, coyotes, and bobcats. Small mammals are the deer mouse, longtail weasel, porcupine, golden-mantled ground squirrel, Colorado chipmunk, red squirrel, wood rat, pocket gopher, longtail vole, Kaibab (Abert) squirrel, and cottontail.

Some of the more common birds are the northern pygmy-owl, olive warbler, red-faced warbler, hepatic tanager, mountain bluebird, pygmy nuthatch, white-breasted nuthatch, Mexican junco, Steller's jay, red-shafted flicker and the Rocky Mountain sapsucker. Goshawks and red-tailed hawks are present. The only widely found reptile is the short-horned lizard.

Tropical/ Subtropical Desert Division

South of the Arizona-New Mexico Mountains are the continental desert climates, which have not only extreme aridity, but also extremely high air and soil temperatures. Direct sun radiation is very strong, as is outgoing radiation at night, causing extreme variations between day and night temperatures and a rare nocturnal frost. Annual precipitation is less than 8 inches (200 mm), and less than four inches (100 mm) in extreme deserts. These areas have climates that Trewartha (1968) calls BWh.

The region is characterized by dry-desert vegetation, a class of xerophytic plants that are widely dispersed and provide negligible ground cover. In dry periods, visible vegetation is limited to small hard-leaved or spiny shrubs, cacti, or hard grasses. Many species of small annuals may be present, but they appear only after the rare but heavy rains have saturated the soil.

In the Mojave-Sonoran Deserts (American Desert), plants are often so large that some places have a near-woodland appearance. Well known are the treelike saguaro cactus, the prickly pear cactus, the ocotillo, creosote bush, and smoke tree. But much of the desert of the Southwestern United States is in fact scrub, thorn scrub, savanna, or steppe grassland. Parts of this region have no visible plants; they are made up of shifting sand dunes or almost sterile salt flats.

The Subtropical Desert Ecoregion is composed of the Mohave, Sonoran, and Chihuahuan deserts. In contrast to the cooler deserts of the Temperate Desert Ecoregion, the hotter deserts of the Subtropical Desert Ecoregion tend to have a more diverse flora and fauna. The northern limits of many species common in Mexico are found in this ecoregion, such as brown-crested flycatcher, vermilion flycatcher, black-tailed gnatcatcher, hooded skunk, pocketed free-tail bat, coatimundi, and jaguar. The Sonoran Desert is the most floristically diverse of the three deserts, and as a result, has the greatest diversity of wildlife. The desert tortoise, which is federally listed as a threatened species (in the Mojave Desert only), is found in this ecoregion. Long-lived and once common, desert tortoises have suffered population declines due to adverse impacts associated with human activities. The Sonoran pronghorn is classed as an endangered species; few of these animals are left in southern Arizona. The mashed bobwhite quail is also an endangered species. Large ungulates are mostly absent from this ecoregion. Pronghorn antelope and mule deer are the most widely distributed large game animals.

Wildlife species in the Subtropical Desert have evolved numerous means to deal with water scarcity and other rigors of the hot desert. Presence of standing water in winter and new herbaceous growth in spring provide water and forage for most wildlife. During summer and fall, some species, such as the desert kangaroo rat and other rodents, derive water from the seeds in their diet. However, collared peccaries and many desert rodents can avoid or digest cactus spines and obtain water from the plants' succulent tissues.

Black-throated sparrows secrete highly-concentrated urine and dry feces, and thus need little drinking water. In contrast, most other desert-living bird species show few adaptations for coping with water scarcity and simply fly to water sources to meet their needs. Reptiles and small mammals are active mostly at night and retreat to cool burrows, or seek shelter under vegetation or in rock outcrops to avoid the midday sun and reduce water loss.

Salt balance is an important physiological function in desert animals. Chuckwallas are able to excrete salt from their nostrils by sneezing, without losing much water. Many other lizard species, including Desert Iguanas, also have salt glands for excreting salt.

The structure of live vegetation is probably the most important habitat feature in these deserts. Cacti provide breeding and housing habitats for bats and birds, including elf owl, cactus wren, Gila woodpecker and gilded flicker. Lizards use cacti and shrubs for feeding and breeding and climb creosotebush to escape hot ground temperatures during the day. Small mammals such as the blacktailed jackrabbit, desert cottontail, kangaroo rat, wood rat, toads and reptiles utilize the root systems of the creosote bush and other shrubs as protection for burrow openings and to hide from predators such as coyote, bobcat, golden eagle, great horned owl, red-tailed hawk, and ferruginous hawk.

A dominant pedogenic process is salinization, which produces areas of salt crust where only salt-loving (halophytic) plants can survive. Calcification is conspicuous on well-drained uplands, where encrustations and deposits of calcium carbonate (caliche) are common. Humus is lacking and soils are mostly Aridisols and dry Entisols.

Chihuahuan Desert Province

Land-surface form.--This province is mostly desert. Practically the only permanent streams are a few large rivers that originate in humid provinces. The Rio Grande and the Pecos Rivers and a few of their larger tributaries are the only perennial streams. The area has undulating plains with elevations near 4,000 feet (1,200 m), from which somewhat isolated mountains rise 2,000 to 5,000 feet (600 to 1,500 m). Washes, dry most of the year, fill with water following rains. Basins with no outlets drain into shallow playa lakes that dry up during rainless periods. Small whirlwinds constantly play over these dry playas when they are heated by summer sun. Extensive dunes of silica sand cover parts of the province. In a few places there are dunes of gypsum sand, the most notable being the White Sands near Alamogordo in southern New Mexico. In scattered areas, small beds and isolated buttes of blackish lava occur.

Climate.--Summers are long and hot. Winters are short, but may include brief periods when temperatures fall below freezing. Average annual temperatures range from 50 to 65F (10 to 18C). The climate is distinctly arid; spring and early summer are extremely dry. Mean annual precipitation at El Paso, Texas, is 8.65 inches (221 mm). In July, summer rains usually begin, torrential storms that are mostly local and continue through October. The northern part of the province also receives winter rains, which are more gentle and widespread.

Vegetation.--A number of shrubs, most of them thorny, are typical of the Chihuahuan Desert. They frequently grow in open stands, but sometimes form low, closed thickets. In many places, they are associated with short grass, such as grama. Extensive arid grasslands cover most of the high plains of the province. On deep soils, honey mesquite is often the dominant plant. Cacti are also abundant, particularly prickly pears, but they are smaller in size and fewer in number of species than in the Sonoran Desert. The desert is characterized by yuccas, so much so that one has been adopted as the state flower of New Mexico. A few cottonwoods and other trees grow beside the widely separated rivers. Creosote bush, which covers great areas in characteristic open stands, is especially common on gravel fans. Though creosote bush is the most abundant plant cover of the province, other species like lechuguilla are also abundant. Another distinctive plant is candelilla, or wax plant. On rocky slopes, the ocotillo is conspicuous. Juniper and pinyons, limited to rocky outcrops, are prominent around the Stockton Plateau in western Texas.

Some isolated mountains in the Chihuahuan Province rise high enough to carry a belt of oak and juniper woodland. On a few of the highest mountains, there are pines among the oaks, in some places forming nearly pure stands. Douglas-fir and white fir occupy a few sheltered upper slopes in the Santa Catalina Mountains.

Soils.--In the western and northern portions of this province, the soils are primarily Aridisols. Both Aridisols and Entisols are present in the south.

Fauna.--Pronghorn antelope and mule deer are the most widely distributed large game animals. Whitetail deer inhabit parts of Texas. The collared peccary or javelina is common in the southern part of the region. The blacktail jackrabbit, desert cottontail, kangaroo rat, wood rat, and numerous smaller rodents compete with domestic and wild herbivores for available forage. Mammalian predators include the coyote and bobcat.

The black-throated sparrow is one of the most abundant birds of the province. Greater roadrunner, curve-billed thrasher, and Chihuahuan raven are also common. Scaled quail and Gambel's quail occupy most of the area, and bobwhite populations reach into its eastern portion. Raptors include the golden eagle, great horned owl, red-tailed hawk, ferruginous hawk, and the rare zone-tailed hawk.

The many reptiles include the common chuckwalla, Texas horned lizard, desert spiny lizard, and various species of rattlesnakes.

American Semidesert and Desert Province

Land-surface form.--The American Desert includes the Mojave, Colorado, and Sonoran Deserts. Its topography is characterized by extensive plains, most gently undulating, from which isolated low mountains and buttes rise abruptly. Elevations range from 280 feet (85 m) below sea level to 4,000 feet (1,200 m) in valleys and basins, with some mountain ranges reaching as high as 11,000 feet (3,400 m). The mountains are rocky and rise abruptly from their outwash aprons and alluvial faces. There are areas of interior drainage, such as the Salton Trough, but a large part of the province drains to the sea through underground seepage or through washes that are dry most of the year. The Colorado River, which crosses the eastern part of the province, is the only sizable stream.

Climate.--Summers are long and hot; the highest temperature ever measured in the United States was 134F (57C) in 1913 at Death Valley. The average annual temperature is 60 to 75F (15 to 24C). Though winters are moderate, the entire province is subject to occasional frosts. In winter the rains are widespread and usually gentle, but in summer they are usually thunderstorms. In the Colorado and Mojave Deserts of southeastern California, there are virtually no summer rains. No part of the province has regular rains, and a year or more may pass without measurable rainfall, especially in the region's western part. Average annual precipitation is 2 to 10 inches (50 to 250 mm) in the valleys, but may reach 25 inches (610 mm) on mountain slopes. The evaporation rate in summer is very high.

Vegetation.--Vegetation is usually very sparse, with bare ground between individual plants. Cacti and thorny shrubs are conspicuous, but many thornless shrubs and herbs are also present. On the Sonoran Desert plains, the most widely distributed plant is the creosote bush, which covers extensive areas in nearly pure stands. On some parts of the plains the arborescent cacti (cholla) are also common. Mesquite is less widespread and grows only along washes and watercourses.

At the base of the mountains, on the gentle rocky slopes called bajadas, the vegetation is dominated by paloverde, ocotillo, and saguaro, but bitterbrush is also a common shrub. Vegetation below 3,000 feet (900 m) in the Mojave Desert is mostly creosote bush and various Atriplex (saltbush) species. The desert mountains are exceptionally barren, and many are almost devoid of vegetation.

Along the higher northern edge of the province is a belt where the Joshua tree is prominent. At a still higher level is a belt of junipers and pinyons.

Interior basins characterized by ephemeral shallow playa lakes are a conspicuous feature of the Mojave Desert. Soils near these playas contain alkali in quantities varying with distance from the lake, resulting in a zonation of several species of vegetation according to their tolerance for salts.

Soils.--Gravel or bare rock covers the ground near the bases of some mountains, and much bare rock is exposed on the mountains because the heavy, violent desert rainstorms allow little soil to accumulate on the steep slopes. Entisols occur on the older alluvial fans and terraces and in the better-drained basins. Aridisols dominate throughout the rest of the province.

Fauna.--Large ungulates are almost absent from the desert. Desert mule deer and peccary live chiefly in the paloverde-cactus shrub community. The Sonoran pronghorn antelope is classified as an endangered species; few are left in southern Arizona. Carnivores, including the desert kit fox and coyote, are small and usually nocturnal. The western spotted skunk is common. Nocturnal burrowers, particularly kangaroo rats and pocket mice, dominate. Merriam kangaroo rat is closely associated with creosote bush. Other important species are the longtail pocket mouse and antelope ground squirrel.

Many desert birds are very selective in their type of habitat. Greasewood may furnish a permanent residence for the loggerhead shrike. Areas where tall cacti are plentiful furnish homes for many birds, including the Gila woodpecker, elf owl, and purple marten. Gambel's quail, the cactus wren, and the roadrunner are common in the southern part of the region. The masked bobwhite quail is an endangered species that has been reintroduced.

Reptiles include numerous species of snakes and lizards, such as the Gila monster, the only poisonous lizard in the United States. The desert tortoise is becoming increasingly rare and is everywhere protected.

Endemic species, common in the Mojave Desert, include five species of desert pupfish living in highly saline lakes in Death Valley.

Temperate Steppe Division

Temperate steppes are areas with a semiarid continental climatic regime in which, despite maximum summer rainfall, evaporation usually exceeds precipitation. There is a cool climate with at least one month of average temperatures below 32F (0C). Winters are cold and dry, summers warm to hot. The vegetation is steppe, sometimes called shortgrass prairie, and semidesert. Typical steppe vegetation consists of numerous species of short grasses that usually grow in sparsely distributed bunches. Scattered shrubs and low trees sometimes grow in the steppe; all gradations of cover are present, from semidesert to woodland. Because ground cover is generally sparse, much soil is exposed. Many species of grasses and other herbs occur. Buffalo grass is typical of the American steppe; other typical plants are the sunflower and locoweed.

The semidesert cover is a xerophytic shrub vegetation accompanied by a poorly developed herbaceous layer. Trees are generally absent. An example of semidesert cover is the sagebrush vegetation of the middle and southern Rocky Mountain region and the Colorado Plateau.

In this climatic regime, the dominant pedogenic process is calcification, with salinization on poorly drained sites. Soils contain a large excess of precipitated calcium carbonate and are very rich in bases. Mollisols are typical in steppe lands. The soils of the semidesert shrub are Aridisols with little organic content, pedogenic and (occasionally) clay horizons, and (in some places) accumulations of various salts. Humus content is small because the vegetation is so sparse.

Great Plains- Palouse Dry Steppe Province

Land-surface form.--This region is characterized by rolling plains and tablelands of moderate relief in a broad belt that slopes gradually eastward from an altitude of 5,500 feet (1,520 m) near the foot of the Rocky Mountains to 2,500 feet (760 m) in the Central States. The plains are notably flat, but there are occasional valleys, canyons, and buttes. In the northern section, badlands and isolated mountains break the continuity of the plains. The Palouse region occupies a series of loess-covered basalt tablelands with moderate to high relief, ranging in altitude from 1,200 to 6,000 feet (370 to 1,800 m).

Climate.--This region lies in the rain shadow east of the Cascade Range and the Rocky Mountains. The climate of the Great Plains grasslands is a semiarid continental regime. The average annual temperature is 45F (7C) throughout most of the region, but can reach as high as 60F (16C) in the south. Winters are cold and dry, and summers are warm to hot. The frost-free season ranges from fewer than 100 days in the north to more than 200 days in Oklahoma. Precipitation ranges from 10 inches (260 mm) in the north to more than 25 inches (640 mm) in the south, with maximum rainfall in summer. Evaporation usually exceeds precipitation, and the total supply of moisture is low. When precipitation does occur, it is often in the form of hail or blizzards, and tornadoes and dust storms are frequent.

The climate of the Palouse grassland east of the Cascades is similar to that of the Great Plains grasslands east of the Rockies, except for the timing of precipitation: on the Palouse dry steppe, there is a winter maximum.

Vegetation.--Steppe, sometimes called shortgrass prairie, is a formation class of short grasses usually bunched and sparsely distributed. The steppe in this province is dry, with 6-7 arid months per year. The Great Plains grasslands east of the Rockies have scattered trees and shrubs, such as sagebrush and rabbitbrush, and support all gradations of cover, from semidesert to woodland. Because ground cover is scarce, much soil is exposed.

Many species of grasses and herbs grow in this province. A typical grass is buffalo grass; sunflower and locoweed are typical plants. Other grasses include grama, wheatgrass, and needlegrass. Many wildflower species bloom in spring and summer. The blazingstar and white prickly poppy are usually abundant. The alien Russian-thistle, also know as tumbleweed, is sometimes abundant.

Except for the presence of shrubs, the Palouse grassland resembles the Great Plains shortgrass prairie. The dominant species, however, are distinctive. They include bluebunch wheatgrass, fescue, and bluegrass.

Soil.--In this climatic regime, the dominant pedogenic process is calcification; salinization is dominant on poorly drained sites. Soils contain a large excess of precipitated calcium carbonate and are rich in bases. Mollisols are typical. Humus content is small because vegetation is sparse.

Fauna.--Large herds of buffalo migrated with the seasons across the steppe plains. Now the pronghorn antelope is probably the most abundant large mammal, but mule deer and whitetail deer are common where brush cover is available along stream courses. The whitetail jackrabbit occupies the northern part of the province, with the blacktail jackrabbit in the area south of Nebraska. The desert cottontail is widespread. The lagomorphs, prairie dogs, and several other small rodents are preyed upon by the coyote and several other mammalian and avian predators; one, the blackfooted ferret, is classified as an endangered species. The thirteen-lined ground squirrel is common here; both prairie dogs and ground squirrels are preyed upon by badgers. The Washington and Columbia ground squirrels inhabit large areas of the Palouse grassland.

The lesser prairie chicken, once abundant, is now classified as threatened. Sage grouse, greater prairie chickens, and sharp-tailed grouse are present in the area. Among the many smaller birds are the horned lark, lark bunting, and western meadowlark. Two bird species are unique to the shortgrass prairies east of the Rockies, the mountain plover and McCown's longspur. Mountain plovers, which resemble killdeer, live in small flocks often seen feeding in freshly plowed fields. Construction of stock ponds has created an important "duck factory" in the northern Great Plains.

Southern Rocky Mountain Steppe--Open Woodland--Coniferous Forest--Alpine Meadow Province

Land-surface form.--The Rocky Mountains are rugged glaciated mountains as high as 14,000 feet (4,300 m). Local relief is between 3,000 feet (900 m) and 7,000 feet (2,100 m). Several sections have intermontane depressions ("parks") with floors less than 6,000 feet (1,800 m) in altitude. Many high-elevation plateaus composed of dissected, horizontally layered rocks lie in Wyoming and Utah.

Climate.--The climate is a temperate semiarid steppe regime with average annual temperatures ranging from 35 to 45F (2 to 7C) in most of the region, but reaching 50F (10C) in the lower valleys. Climate is influenced by the prevailing west winds and the general north-south orientation of the mountain ranges. East slopes are much drier than west slopes; individual mountain ranges have similar east-west slope differences region wide. Winter precipitation varies considerably with altitude. Total precipitation is moderate, but greater than on the plains to the east and west. In the highest mountains, a considerable part of annual precipitation is snow, although permanent snowfields and glaciers cover only relatively small areas. Bases of these mountains receive only 10 to 20 inches (260 to 510 mm) of rainfall per year. At higher elevations, annual precipitation increases to 40 inches (1,020 mm), and average temperatures fall.

Vegetation.--A striking feature of the region is its pronounced vegetational zonation, controlled by a combination of altitude, latitude, direction of prevailing winds, and slope exposure. Generally, the various zones are at higher altitudes in the southern part of the province than in the northern, and they extend downward on east facing and north facing slopes and in narrow ravines and valleys subject to cold air drainage. The uppermost (alpine) zone is characterized by alpine tundra and the absence of trees. Directly below it is the subalpine zone, dominated in most places by Engelmann spruce and subalpine fir. Below this area lies the montane zone, characterized by ponderosa pine and Douglas-fir, which frequently alternate--ponderosa pine dominates on lower, drier, more exposed slopes, and Douglas-fir is predominant in higher, moister, more sheltered areas.

After fire in the subalpine zone and in the upper part of the montane zone, the original forest trees are usually replaced by aspen or lodgepole pine.

Grass, often mixed with sagebrush, regularly covers the ground in open ponderosa pine forests and some treeless areas. These treeless openings are usually small, and they often alternate (depending on slope exposure) with ponderosa pine forest. At the lower edge of the montane zone, they may open onto the adjacent grass and sagebrush belt.

Below the montane belt is the foothill (woodland) zone. Dry rocky slopes in this zone often have a growth of shrubs in which mountain-mahogany and several kinds of scrub oak are conspicuous. Along the border of the Colorado Plateau Province, ponderosa pine and pinyon-juniper associations frequently alternate, depending on slope exposure.

Unforested parks are a conspicuous feature of this province. Many are dominated by grasses, but some are covered largely by sagebrush and other shrubs, such as antelope bitterbrush.

Soils.--In the Rocky Mountains, soil orders occur in zones corresponding to vegetation, ranging from Mollisols and Alfisols in the montane zone to Aridisols in the foothill zone. In addition, because of steep slopes and recent glaciation, there are areas of Inceptisols.

Fauna.--Common large mammals include elk, deer, bighorn sheep, mountain lion, bobcat, beaver, porcupine, and black bear. Grizzly bear and moose inhabit the province's northern portions. Small mammals include mice, squirrels, martens, chipmunks, mountain cottontails, and bushytail woodrats.

Common birds include the mountain bluebird, chestnut-backed chickadee, red-breasted nuthatch, ruby-crowned kinglet, pygmy nuthatch, gray jay, Steller's jay, and Clark's nutcracker. Rosy finches are found in the high snowfields. Blue and ruffed grouse are the most common upland game birds. Hawks and owls inhabit most of the region.

Middle Rocky Mountain Steppe--Coniferous Forest--Alpine Meadow Province

Land-surface form.--Most of central Idaho and the Salmon River Mountains are formed by granitic intrusions that collectively make up the Idaho Batholith, with altitudes ranging from 3,000 to 7,000 feet (900 to 2,130 m). The batholith is deeply dissected, with a relief greater than 3,000 ft, and its granite is heavily weathered over large areas. East of the batholith is a basin-and-range area consisting of mountains, alluvial fans at their bases, and floodplains along the streams draining the valleys. To the west lie the Blue Mountains, which seldom exceed 8,000 feet (2,400 m) but have at least one peak 10,000 feet (3,050 m) high. The Snake River crosses the province at the bottom of Hells Canyon, which is deeper than the Grand Canyon. Many of the region's higher reaches have been glaciated.

Climate.--Despite the northerly latitudes and high altitudes of this region, its climates are surprisingly mild due to their proximity to the Pacific Ocean. Mean monthly temperatures at Canyon City, Oregon (near John Day), range from just above freezing to 68F (20C). In the mountain valleys of Montana, January temperatures average as much as 10F (6C) higher and summer temperatures 5 to 10F (3 to 6C) lower than on the Great Plains just to the east. The average length of the growing season is about the same as on the Great Plains, roughly 120 days. Temperature and snowfall, of course, vary greatly with altitude. Winds are from the west, with much of their moisture precipitated where they cross the Pacific ranges. Consequently, most of this portion of the Rocky Mountains is semiarid. Valleys get less than 20 inches (510 mm) of precipitation each year; up to 30 inches (770 mm) falls in the mountains, mostly as snow.

Vegetation.--Altitudinal zones are evident. Below the subalpine zone, Douglas-fir is the climax dominant, with grand fir as an associate west of the continental divide, chiefly on west facing slopes. Lodgepole pines and grasses grow principally in the basins and ranges in the eastern and southeastern part of the province. Below the Douglas-fir belt, ponderosa pine is dominant to the west of the continental divide, constituting a xerophytic forest. The lower slopes of the mountains and the basal plain are dominated by sagebrush semidesert or steppe.

Due to aridity, forests directly east of the Bitterroot Mountains are usually restricted to northern and eastern slopes. Although south- and west facing slopes receive comparable precipitation, they are hotter and evaporation is higher. Consequently, they support few trees and are covered by shrubs and grasses.

Soils.--Soils of the fans and valley floors, most of which lie below 2,000 feet (600 m), are Mollisols. These soils support sagebrush and grass. Above 2,000 feet, under coniferous forest, the soils are Alfisols. Areas recently glaciated or with steep slopes have Inceptisols.

Fauna.--Fauna in the Middle Rocky Mountain Province are like those elsewhere in the Rockies to the north and south. However, parts of the province are filled with mountain ranges that are isolated by stretches of arid territory. Each such range usually contains a group of species peculiar to the region, and some of these species may be found only in a single range.

Northern Rocky Mountain Forest-Steppe--Coniferous Forest--Alpine Meadow Province

Land-surface form.--The Northern Rocky Mountain Province consists of high, rugged mountains rising to more than 9,000 feet (2,700 m), with a local relief in excess of 3,000 feet (900 m). Most of the region has been glaciated. In the several Rocky Mountain trenches, there are flat or nearly flat valleys, some of which are several miles wide.

Climate.--Severe winters are usual. The average temperature of the coldest month is below 32F (0C), and the average temperature of the warmest month is below 72F (22C). Summer days are often hot and nights cool. Precipitation averages 20 to 40 inches (510 to 1,020 mm) per year and is concentrated in fall, winter, and spring. Summers are usually dry, because westerly air masses draw the dry climate of the Pacific coast across the area. As a result, there is a distinct climatic gradient from north to south and east to west. Snowfall in winter is heavy, but permanent snowfields and glaciers cover only rather small areas.

Vegetation.--Mixed evergreen-deciduous forest predominates; Douglas-fir forest and cedar-hemlock-Douglas-fir forest are the two major types.

Well-marked life belts are a striking feature of the province. In the uppermost (alpine) belt, trees are absent. The subalpine belt is dominated in most places by Engelmann spruce and subalpine fir. In the Bitterroot Range, mountain hemlock is said to be the climax tree of the subalpine belt. Western redcedar and western hemlock are characteristic of the montane belt. Associated trees include Douglas-fir (found throughout the region), along with western white pine, western larch, grand fir, and western ponderosa pine (found in the south). In these forests, areas that have been burned or cut are invaded first by larch, a deciduous conifer. White pine may crowd out the larch, then be replaced by hemlock, redcedar, and lowland white fir. Depending on latitude, the lower part of the montane belt may be interspersed with grass and sagebrush.

Soils.--Soils are mostly cool, moist Inceptisols. A variety of igneous, sedimentary, and metamorphic rocks form the mountain masses. But compared to other parts of the Rocky Mountains, the shallowness and stoniness of soils play a relatively minor role in forest distribution. In the foothills of the Rockies and to the south of the glacial border, the loess and volcanic ash deposited on the slopes have helped to form excellent soils.

Fauna.--Large mammals in this province include black bear, deer, elk, mountain goat, mountain lion, and bobcat. Smaller mammals include Columbia ground squirrel, flying squirrel, marten, redtail chipmunk, and bushytail woodrat.

Some familiar birds are hawks, jays, chestnut-backed chickadees, red-breasted nuthatches, and great gray owls. Blue and ruffed grouse are the most common game birds.

Temperate Desert Division

Temperate deserts of continental regions have low rainfall and strong temperature contrasts between summer and winter. In the intermountain region of the Western United States between the Pacific coast and Rocky Mountains, the temperate desert has characteristics of a sagebrush semidesert, with a very pronounced drought season and a short humid season. Most precipitation falls in winter, despite a peak in May. Aridity increases markedly in the rain shadow of the Pacific mountain ranges. Even at intermediate elevations, winters are long and cold, with temperatures falling below 32F (0C).

These deserts differ from those at lower latitudes chiefly in their far greater annual temperature range and much lower winter temperatures. Unlike the dry climates of the tropics, dry climates in the middle latitudes receive part of their precipitation as snow.

Temperate desert climates support the sparse xerophytic shrub vegetation typical of semidesert. One example is the sagebrush vegetation of the Great Basin and northern Colorado Plateau. Recently, semidesert shrub vegetation seems to have invaded wide areas of the Western United States that were formerly steppe grasslands, due to overgrazing and trampling by livestock. Soils of the temperate desert are Aridisols low in humus and high in calcium carbonate. Poorly drained areas develop saline soils, and dry lake beds are covered with salt deposits.

Northern, cooler desert regions, such as the Great Basin Desert, support far fewer wildlife species than southern, warmer deserts found in the Subtropical Desert Division due to a shorter growing season which results in lower plant productivity and a lower diversity and abundance of animal prey. Thermal regimes in northern deserts also limit the activity of wildlife, especially cold-blooded animals such as amphibians and reptiles, to short periods each year.

The Great Basin Desert, which is the largest desert in North America, is characterized by sagebrush and saltbush. This desert supports large populations of pronghorn antelope, and also provides critical habitat for sage-grouse species that use sagebrush for food and cover.

Similarly to the Subtropical Desert division, wildlife of the Temperate Desert has adapted to survive under extreme environmental conditions, including low, erratic rainfall, and highly variable temperatures. Spadefoot toads have a special appendage on their hind foot that allows them to burrow into the soil to avoid daytime heat, and breeding activities are timed to occur during periods with summer thunderstorms. Many small mammals are able to survive on metabolically-produced water and secret hyper-concentrated urea. Despite these adaptations, riparian areas are especially important in the desert. For example, of the 148 species of breeding birds in the Great Basin Desert, 131 are dependent upon riparian areas for all or part of their life requisites.

Reptiles such as the common garter snake, western rattlesnake and sagebrush lizard are found among the talus slopes, cliffs and rock outcroppings, which provide thermal and escape cover, nesting and feeding habitat. Bats use caves and rock outcroppings as root and nursery sites. Deep, rugged cliffs are used by desert bighorn sheep for lambing, escape, and thermal cover. Raptors, including golden eagles and several species of hawks use cliffs and rock outcrops as nest and perch sites. The canyon walls of Snake River provide habitat for one of the highest densities of raptors in the world.

Due to the conversion of lands to agricultural and urban uses, species associated with native perennial bunchgrass communities, including the Columbian sharp-tailed grouse, kit fox, and Idaho ground squirrel, have declined in numbers more than other species' groups in the region. These species rely on grassland vegetation for plant and insect forage, nesting and brood-rearing habitat, and hiding cover.

Intermountain Semidesert and Desert Province

Land-surface form.--The Intermountain Desert Province covers the physiographic section called the Great Basin and the northern Colorado Plateau in Utah. Much of this area is made up of separate interior basins; only a small part of it drains to the sea. The lower parts of many basins have heavy accumulations of alkaline and saline salts. Streams are rare and few are permanent. Many mountains rise steeply from the semiarid, sagebrush-covered plains. These mountains are generally well covered by vegetation, and their upper elevations usually bear sparse conifer forests.

Climate.--Summers are hot, but winters are only moderately cold. The average annual temperature ranges from 40 to 55F (4 to 13C). Spring comes early, except at higher elevations. Annual precipitation averages only 5 to 20 inches (130 to 490 mm), often falling as winter snow. Almost no rain falls during the summer months except in the mountains.

Vegetation.--Sagebrush dominates at lower elevations. Other important plants in the sagebrush belt are antelope bitterbrush, shadscale, fourwing saltbush, rubber rabbitbrush, spiny hopsage, horsebrush, and short-statured Gambel oak. All these shrubs tolerate alkali to varying degrees, essential to their survival on the poorly drained soils widespread in the region. On soils with the highest concentrations of salt, even these shrubs are unable to grow; they are replaced by plant communities dominated by greasewood or saltgrass.

Although sagebrush now dominates this zone, it may not represent climax growth, but rather a disclimax produced by overgrazing. In plots protected from fire, grasses typical of the Palouse grassland or mixed-grass steppe gradually become dominant.

Above the sagebrush belt lies a woodland zone dominated by pinyon pine and juniper, similar to the pinyon-juniper woodland of the Colorado Plateau.

In the montane belt above the woodland zone, ponderosa pine generally occupies the lower and more exposed slopes and Douglas-fir the higher and more sheltered ones. In the subalpine belt, the characteristic trees are subalpine fir and Engelmann spruce. Only a few mountains rise high enough to support an alpine belt.

Soils.--Aridisols dominate all basin and lowland areas; forest soils are found at higher elevations. Narrow bands of Entisols lie in stream floodplains and rocky landscapes. Salt flats and playas without soils are extensive in the lower parts of basins with interior drainage.

Fauna.--Few large mammals live in this province, but mule deer, mountain lion, bobcat, and badger occasionally venture into it. Sagebrush provides ideal habitat for pronghorn antelope and whitetail prairie dog. The most common species are such small mammals as ground squirrels, jackrabbits, kangaroo mice, wood rats, and kit foxes. In the lower life belts, some ground squirrels--especially the Belding and Townsend ground squirrels--become dormant during the hot, dry summer.

Bird species range from the burrowing owl to such specialized species as sage sparrow and sage thrasher, both found only in sagebrush habitat. Raptors include the American kestrel and golden eagle, along with the ferruginous hawk and various other species of western hawks. In early spring, groups of sage grouse engage in elaborate courtship displays.

Intermountain Semidesert Province

Land-surface form.--This province covers the plains and tablelands of the Columbia-Snake River Plateaus and Wyoming Basin. The plateaus include most of the Northwest's lava fields. Lying at about 3,000 feet (900 m), the plateaus are surrounded by lavas that have been folded or faulted into ridges. To the south, the plateaus grade into the basins and ranges of the Intermountain Desert Province. The Wyoming Basin consists of plains at elevations of 6,000-8,000 feet (1,800-2,400 m) broken by isolated hills and low mountains 1,000-2,000 feet (300-600 m) higher. In the south, broad intermountain basins and isolated small mountain ranges merge into a dissected plateau. Sloping alluvial fans at the edges of the basins merge into flat plains in the center. Badlands are typical of the dissected areas along the region's outer edges.

Climate.--The climate of the plateaus is semiarid and cool, with an average annual temperature of about 50F (10C). Average annual precipitation ranges from less than 10 inches (260 mm) in the west (in the rain shadow of the Cascade Range) to 20 inches (510 mm) in the east. Precipitation is fairly evenly distributed throughout the year, except during the summer months, when there is little rain.

The higher overall elevation of the Wyoming Basin gives it slightly lower average temperatures and precipitation than on the plateaus. Winters are cold, and summers are short and hot. Average annual temperatures range from 40 to 52F (4 to 11C), and the average growing season has fewer than 100 days in the south and 140 days in the north and east. Average annual precipitation ranges from 5 to 14 inches (130 to 360 mm), and is fairly evenly distributed throughout the year.

Vegetation.--The chief vegetation, sometimes called sagebrush steppe, is made up of sagebrush or shadscale mixed with short grasses. Moist alkaline flats support alkali-tolerant greasewood. Along streams in and near the mountains where the water is good, valley bottoms are lined with willows and sedges, which give way to greasewood and other alkali-tolerant plants as one moves away from the mountains. Lands in the Columbia River Basin with more than 10 inches (260 mm) of rainfall per year have an open cover of bunchgrass, and are excellent for raising wheat. A woodland of western juniper covers parts of central Oregon that get little rain.

Soils.--This province has extensive alluvial deposits in the floodplains of streams and in the fans at the foot of mountains. Dry lake beds are numerous, and there are extensive eolian deposits, including both dune sand and loess. In the Columbia River Basin, loess deposits are up to 150 feet (46 m) thick, and soils developed from them are correspondingly complex. Aridisols dominate all basin and lowland areas; Mollisols are found at higher elevations.

Soils in the Wyoming Basin are alkaline Aridisols. Subsoils contain a layer enriched with lime and/or gypsum, which may develop into a caliche hardpan. Because the basin is semiarid and weathering is therefore slight, soil texture and composition are governed by parent materials. Entisols are found in the Bighorn basin.

Fauna.--Because of its wilderness character, this region supports a great variety of wildlife species. In winter, seasonal changes force many birds and mammals to move from the mountains into the sagebrush semidesert, where they find suitable habitat alongside the area's permanent residents.

Major mammals are coyote, pronghorn antelope, mountain lion, and bobcat. Smaller species include Wyoming ground squirrel, whitetail prairie dog, deer mouse, whitetail jackrabbit, and porcupine. During severe winters, elk and mule deer move into the desert. Moose are locally important in the dense willow thickets along the desert watercourses of eastern Idaho and western Wyoming.

This region is an important breeding and resting ground for migrating waterfowl. Mallards, pintails, green-winged teal, and gadwalls are most common. Canada geese are locally important. Sage grouse are the most abundant upland game bird. The numerous raptors here include Swainson's hawk, ferruginous hawk, rough-legged hawk, red-tailed hawk, marsh hawk, prairie falcon, great horned owl, and burrowing owl.

Reptiles include sagebrush lizard, horned lizard, and prairie rattlesnake.

Nevada-Utah Mountains Semidesert--Coniferous Forest--Alpine Meadow Province

Land-surface form.--This province covers the highest areas of the Great Basin and Colorado Plateau, including valleys that are 5,000 feet (1,500 m) in elevation. Although some valleys are closed, none contain perennial lakes. Streams are rare and few are permanent. Many linear mountain ranges rise steeply from the semiarid plains, reaching altitudes up to 13,000 feet (3,960 m). They are composed mostly of folded and faulted sedimentary rocks block faulted to produce basins and ranges. To the east, on the Colorado Plateau, the mountains are formed from high-elevation plateaus composed of dissected, horizontally layered rocks.

Climate.--This region has a high-altitude variation of the temperate desert climate, with a very pronounced drought season and a short humid season. Most precipitation falls in winter, despite a peak in August. Winters are long, and climate varies considerably with altitude. Average annual temperatures range from about 38F (3C) 50F (10C) in the valleys to 50F (10C) 38F (3C) on upper mountain slopes. Average annual precipitation ranges from 5 to 8 inches (130 to 200 mm) in the valleys to 25 to 35 inches (640 to 890 mm) at higher elevations. A considerable portion of winter precipitation is snow, and summer afternoon thunderstorms are common on the Colorado Plateau.

Vegetation.--Sagebrush dominates at lower elevations. Other important plants in the sagebrush belt are shadscale, fourwing saltbush, rubber rabbitbrush, spiny hopsage, and horsebrush. All tolerate alkali to varying degrees, essential to their survival on the poorly drained soils widespread in the region. Where salt concentrations are very high, even these shrubs are unable to grow; they are replaced by plant communities dominated by greasewood or saltgrass.

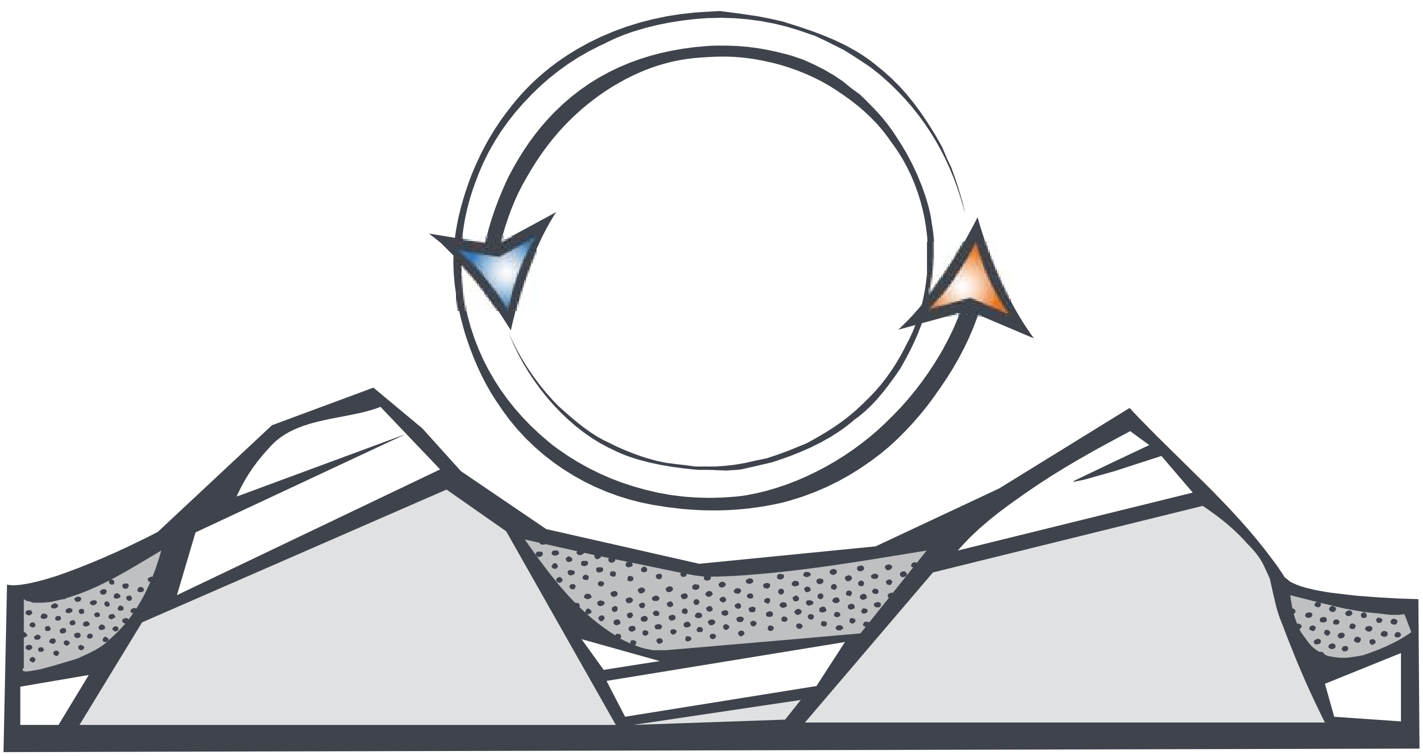
The woodland belt above the sagebrush zone is similar to the corresponding belt on the Colorado Plateau, with juniper and pinyon occupying lower mountain slopes. The belt is frequently interrupted as mountains give way to plains.

In the montane zone above the woodland belt, ponderosa pine generally occupies the lower and more exposed slopes and Douglas-fir the higher and more sheltered ones. Typical species of the subalpine belt are alpine fir and Engelmann spruce. Great Basin bristlecone pine, with some individuals more than 1,000 years old, occupies widely scattered peaks. Only a few mountains in this province rise high enough to support an alpine meadow belt.

Soils.--Aridisols dominate all basin and lowland areas; Mollisols and Alfisols are found at higher elevations in the mountains. Salt flats and playas without soil are extensive in the Great Basin.

Fauna.--Sagebrush shrublands provide ideal habitat for pronghorn antelope and whitetail prairie dog. Golden-mantled squirrels inhabit the region's ponderosa pine forests, and snowshoe hares along with red squirrels are found throughout the spruce-fir forests of Utah.

The sagebrush shrublands contain many species of birds, ranging from burrowing owls to such specialized species as sage sparrow and sage thrasher, both found in no other type of habitat. Various raptors prey on jackrabbits, including the American kestrel, ferruginous hawk, and golden eagle. The pinyon jay is typical of the pinyon-juniper forest, which also supports the plain titmouse and black-throated gray warbler, along with flocks of bushtits. Ponderosa pine forests contain the Steller's jay and dark-eyed junco. Many reptiles can be found; collared lizards are common.



Appendix H

Federally Listed Species

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Scientific Name	Common Name	Listing Status[a]	State in which Species could Occur	Designated Critical Habitat	Recovery Plan
Plants					
Abronia alpina	Ramshaw Meadows sandverbena	C	CA	N	N
Acanthomintha ilicifolia	San Diego thornmint	T	CA	N	N
Acanthomintha obovata duttonii	San Mateo thornmint	E	CA	N	Y
Allium munzii	Munz's onion	E	CA	N	N
Alopecurus aequalis var. sonomensis	Sonoma alopecurus	E	CA	N	N
Ambrosia pumila	San Diego ambrosia	E	CA	N	N
Amsinckia grandiflora	Large-flowered fiddleneck	E	CA	Y	Y
Amsonia kearneyana	Kearney's blue-star	E	AZ	N	Y
Arabis mcdonaldiana	McDonald's rock-cress	E	CA	N	Y
Arctomecon humilis	Dwarf bear-poppy	E	UT	N	Y
Arctostaphylos glandulosa crassifolia	Del Mar manzanita	E	CA	N	N
Arctostaphylos hookeri var. ravenii	Presidio manzanita	E	CA	N	Y
Arctostaphylos morroensis	Morro manzanita	T	CA	N	Y
Arctostaphylos myrtifolia	Ione manzanita	T	CA	N	N
Arctostaphylos pallida	Pallid manzanita	T	CA	N	Y
Arenaria paludicola	Marsh sandwort	E	CA	N	Y
Arenaria ursina	Bear Valley sandwort	T	CA	N	N
Argemone pleiacantha pinnatisecta	Sacramento prickly poppy	E	NM	N	Y
Artemisia campestris var. wormskioldii	Northern wormwood	C	OR, WA	N	N
Asclepias welshii	Welsh's milkweed	T	AZ, UT	Y	Y
Astragalus albens	Cushenbury milk-vetch	E	CA	Y	Y
Astragalus ampullarioides	Shivwits milk-vetch	E	UT	Y	Y
Astragalus applegatei	Applegate's milk-vetch	E	OR	N	Y
Astragalus brauntonii	Braunton's milk-vetch	E	CA	Y	Y
Astragalus clarianus	Clara Hunt's milk-vetch	E	CA	N	N
Astragalus cremnophylax var. cremnophylax	Sentry milk-vetch	E	AZ	N	Y
Astragalus desereticus	Deseret milk-vetch	T	UT	N	N
Astragalus holmgreniorum	Holmgren milk-vetch	E	AZ, UT	Y	Y
Astragalus humillimus	Mancos milk-vetch	E	CO, NM	N	Y
Astragalus jaegerianus	Lane Mountain milk-vetch	E	CA	Y	N
Astragalus lentiginosus var. coachellae	Coachella valley milk-vetch	E	CA	Y	N
Astragalus lentiginosus var. piscinensis	Fish Slough milk-vetch	T	CA	N	Y
Astragalus magdalenae var. peirsonii	Peirson's milk-vetch	T	CA	Y	N
Astragalus montii	Heliotrope milk-vetch	T	UT	N	Y
Astragalus osterhoutii	Osterhout milk-vetch	E	CO	N	Y
Astragalus phoenix	Ash Meadows milk-vetch	T	NV	Y	Y
Astragalus pycnostachyus var. lanosissimus	Ventura Marsh milk-vetch	E	CA	Y	N
Astragalus tener var. titi	Coastal dunes milk-vetch	E	CA	N	Y
Astragalus tortipes	Sleeping Ute milk-vetch	C	CO	N	N
Astragalus tricarinatus	Triple-ribbed milk-vetch	E	CA	N	N
Atriplex coronata var. notatior	San Jacinto Valley crownscale	E	CA	N	N
Baccharis vanessae	Encinitas baccharis	T	CA	N	N
Berberis nevinii	Nevin's barberry	E	CA	N	N

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Blennosperma bakeri	Sonoma sunshine	E	CA	N	N
Brodiaea filifolia	Thread-leaved brodiaea	T	CA	Y	Y
Brodiaea pallida	Chinese Camp brodiaea	T	CA	N	N
Calochortus persistens	Siskiyou mariposa lily	C	CA	N	N
Calochortus tiburonensis	Tiburon mariposa lily	T	CA	N	Y
Calyptridium pulchellum	Mariposa pussypaws	T	CA	N	N
Calystegia stebbinsii	Stebbins' morning-glory	E	CA	N	Y
Camissonia benitensis	San Benito eveningprimrose	T	CA	N	Y
Carex albida	White sedge	E	CA	N	N
Carex specuicola	Navajo sedge	T	AZ, UT	Y	Y
Castilleja affinis neglecta	Tiburon paintbrush	E	CA	N	Y
Castilleja campestris succulenta	Fleshy owl's-clover	T	CA	Y	Y
Castilleja christii	Christ's paintbrush	C	ID	N	N
Castilleja cinerea	Ash-grey paintbrush	T	CA	N	N
Castilleja levisecta	Golden paintbrush	T	WA	N	Y
Castilleja mollis	Soft-leaved paintbrush	E	CA	N	Y
Caulanthus californicus	California jewelflower	E	CA	N	Y
Ceanothus ferrisae	Coyote ceanothus	E	CA	N	Y
Ceanothus ophiochilus	Vail Lake ceanothus	T	CA	N	N
Ceanothus roderickii	Pine Hill ceanothus	E	CA	N	Y
Centaurium namophilum	Spring-loving centaury	T	CA, NV	Y	Y
Chamaesyce hooveri	Hoover's spurge	T	CA	Y	N
Chlorogalum purpureum	Purple amole	T	CA	Y	N
Chorizanthe howellii	Howell's spineflower	E	CA	N	Y
Chorizanthe orcuttiana	Orcutt's spineflower	E	CA	N	N
Chorizanthe parryi var. fernandina	San Fernando Valley spineflower	C	CA	N	N
Chorizanthe pungens var. hartwegiana	Ben Lomond spineflower	E	CA	N	Y
Chorizanthe pungens var. pungens	Monterey spineflower	T	CA	Y	Y
Chorizanthe robusta	Robust spineflower	E	CA	Y	Y
Chorizanthe valida	Sonoma spineflower	E	CA	N	Y
Cirsium fontinale var. fontinale	Fountain thistle	E	CA	N	Y
Cirsium fontinale var. obispoense	Chorro Creek bog thistle	E	CA	N	Y
Cirsium hydrophilum var. hydrophilum	Suisun thistle	E	CA	Y	N
Cirsium loncholepis	La Graciosa thistle	E	CA	Y	N
Cirsium vinaceum	Sacramento Mountains thistle	T	NM	N	Y
Clarkia franciscana	Presidio clarkia	E	CA	N	Y
Clarkia imbricata	Vine Hill clarkia	E	CA	N	N
Clarkia speciosa immaculata	Pismo clarkia	E	CA	N	Y
Clarkia springvillensis	Springville clarkia	T	CA	N	N
Cordylanthus maritimus maritimus	Salt marsh bird's-beak	E	CA	N	Y
Cordylanthus mollis mollis	Soft bird's-beak	E	CA	Y	Y
Cordylanthus palmatus	Palmate-bracted bird's beak	E	CA	N	Y
Cordylanthus tenuis capillaris	Pennell's bird's-beak	E	CA	N	Y
Coryphantha robbinsorum	Cochise pincushion cactus	T	AZ	N	Y
Coryphantha scheeri var. robustispina	Pima pineapple cactus	E	AZ	N	N

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Coryphantha sneedii var. leei	Lee pincushion cactus	T	NM	N	Y
Coryphantha sneedii var. sneedii	Sneed pincushion cactus	E	NM	N	Y
Cupressus abramsiana	Santa Cruz cypress	E	CA	N	Y
Cupressus goveniana goveniana	Gowen cypress	T	CA	N	Y
Cycladenia jonesii	Jones cycladenia	T	AZ, UT	N	Y
Deinandra conjugens	Otay tarplant	T	CA	Y	Y
Deinandra increscens villosa	Gaviota tarplant	E	CA	Y	N
Delphinium bakeri	Baker's larkspur	E	CA	Y	N
Delphinium luteum	Yellow larkspur	E	CA	Y	N
Dodecahema leptoceras	Slender-horned spineflower	E	CA	N	N
Dudleya abramsii parva	Conejo dudleya	T	CA	N	Y
Dudleya cymosa. marcescens	Marcescent dudleya	T	CA	N	Y
Dudleya cymosa. ovatifolia	Santa Monica Mountains dudleyea	T	CA	N	Y
Dudleya setchellii	Santa Clara Valley dudleya	E	CA	N	Y
Dudleya stolonifera	Laguna Beach liveforever	T	CA	N	N
Dudleya verityi	Verity's dudleya	T	CA	N	Y
Echinocactus horizonthalonius var. nicholii	Nichol's Turk's head cactus	E	AZ	N	Y
Echinocereus fendleri var. kuenzleri	Kuenzler hedgehog cactus	E	NM	N	Y
Echinocereus triglochidiatus var. arizonicus	Arizona hedgehog cactus	E	AZ	N	Y
Echinomastus erectocentrus var. acunensis	Acuna cactus	C	AZ	N	N
Enceliopsis nudicaulis var. corrugata	Ash Meadows sunray	T	NV	Y	N
Eremalche kernensis	Kern mallow	E	CA	N	Y
Eriastrum densifolium sanctorum	Santa Ana river woolly-star	E	CA	N	N
Erigeron decumbens var. decumbens	Willamette daisy	E	OR	N	N
Erigeron lemmonii	Lemmon fleabane	C	AZ	N	N
Erigeron maguirei	Maguire daisy	T	UT	N	Y
Erigeron parishii	Parish's daisy	Y	CA	Y	Y
Erigeron rhizomatus	Zuni fleabane	Y	AZ, NM	N	Y
Eriodictyon altissimum	Indian Knob Mountain balm	E	CA	N	Y
Eriodictyon capitatum	Lompoc yerba santa	E	CA	Y	N
Eriogonum apricum	Ione buckwheat	E	CA	N	N
Eriogonum codium	Umtanum desert buckwheat	C	WA	N	N
Eriogonum corymbosum car. Nilesii	Las Vegas buckwheat	C	NV	N	N
Eriogonum diatomaceum	Churchill Narrows buckwheat	C	NV	N	N
Eriogonum gypsophilum	Gypsum wild-buckwheat	T	NM	Y	Y
Eriogonum kelloggii	Red Mountain buckwheat	C	CA	N	N
Eriogonum kennedyi var. austromontanum	Southern mountain wildbuckwheat	T	CA	N	N
Eriogonum ovalifolium var. vineum	Cushenbury buckwheat	E	CA	Y	Y
Eriogonum ovalifolium var. williamsiae	Steamboat buckwheat	E	NV	N	Y
Eriogonum pelinophilum	Clay-loving wild-buckwheat	E	CO	Y	Y
Eriophyllum latilobum	San Mateo woolly sunflower	E	CA	N	Y
Eryngium aristulatum var. parishii	San Diego button-celery	E	CA	N	Y
Eryngium constancei	Loch Lomond coyote thistle	E	CA	N	Y
Erysimum capitatum var. angustatum	Contra Costa wallflower	E	CA	Y	Y
Erysimum menziesii	Menzies' wallflower	E	CA	N	Y

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Erysimum teretifolium	Ben Lomond wallflower	E	CA	N	Y
Eutrema penlandii	Penland alpine fen mustard	T	CO	N	N
Fremontodendron californicum decumbens	Pine Hill flannelbush	E	CA	N	Y
Fremontodendron mexicanum	Mexican flannelbush	E	CA	N	N
Fritillaria gentneri	Gentner's fritillary	E	OR	N	Y
Galium californicum sierrae	El Dorado bedstraw	E	CA	N	Y
Gaura neomexicana var. coloradensis	Colorado butterfly plant	T	CO, WY	V	N
Gilia tenuiflora arenaria	Monterey gilia	E	CA	N	Y
Gilia tenuiflora hoffmannii	Hoffmann's slenderflowered gilia	E	CA	N	Y
Grindelia fraxino-pratensis	Ash Meadows gumplant	T	CA,NV	Y	Y
Hackelia venusta	Showy stickseed	E	WA	N	Y
Hazardia orcuttii	Orcutt's hazardia	C	CA	N	N
Hedeoma todsenii	Todsen's pennyroyal	E	NM	Y	Y
Helianthus paradoxus	Pecos sunflower	T	NM	N	Y
Hesperolinon congestum	Marin dwarf-flax	T	CA	N	Y
Holocarpha macradenia	Santa Cruz tarplant	T	CA	Y	N
Howellia aquatilis	Water howellia	T	CA, ID, MT, OR, WA	N	Y
Ipomopsis polyantha	Pagosa skyrocket	C	CO	N	N
Ipomopsis sancti-spiritus	Holy Ghost ipomopsis	E	NM	N	Y
Ivesia kingii var. eremica	Ash Meadows ivesia	T	NV	Y	Y
Ivesia webberi	Webber ivesia	C	CA, NV	N	N
Lasthenia burkei	Burke's goldfields	E	CA	N	N
Lasthenia conjugens	Contra Costa goldfields	E	CA	Y	Y
Layia carnosa	Beach layia	E	CA	N	Y
Lepidium barnebyanum	Barneby ridge-cress	E	UT	N	Y
Lesquerella congesta	Dudley Bluffs bladderpod	T	CO	N	N
Lesquerella kingii bernardina	San Bernardino Mountains bladderpod	E	CA	Y	Y
Lesquerella tumulosa	Kodachrome bladderpod	E	UT	N	Y
Lessingia germanorum	San Francisco lessingia	E	CA	N	Y
Lilaeopsis schaffneriana var. recurva	Huachuca water-umbel	E	AZ	Y	N
Lilium occidentale	Western lily	E	CA, OR	N	Y
Lilium pardalinum pitkinense	Pitkin marsh lily	E	CA	N	Y
Limnanthes floccosa californica	Butte County meadowfoam	E	CA	Y	Y
Limnanthes floccosa grandiflora	Large-flowered woolly meadowfoam	E	OR	N	Y
Limnanthes vinculans	Sebastopol meadowfoam	E	CA	N	Y
Lomatium bradshawii	Bradshaw's desert-parsley	E	OR, WA	N	Y
Lomatium cookii	Cook's lomatium	E	OR	N	Y
Lupinus nipomensis	Nipomo Mesa lupine	E	CA	N	N
Lupinus sulphureus kincaidii	Kincaid's lupine	T	OR, WA	N	N
Lupinus tidestromii	Clover lupine	E	CA	N	Y
Mentzelia leucophylla	Ash Meadows blazingstar	T	NV	Y	Y
Mirabilis macfarlanei	Macfarlane's four-o'clock	T	ID, OR	N	Y
Monardella linoides viminea	Willowy monardella	E	CA	N	N

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Monolopia congdonii	San Joaquin wooly-threads	E	CA	N	Y
Navarretia fossalis	Spreading navarretia	T	CA	N	Y
Navarretia leucocephala pauciflora	Few-flowered navarretia	E	CA	N	Y
Navarretia leucocephala plieantha	Many-flowered navarretia	E	CA	N	Y
Neostapfia colusana	Colusa grass	T	CA	Y	Y
Nitrophila mohavensis	Amargosa niterwort	E	CA, NV	Y	Y
Oenothera avita eurekensis	Eureka Valley eveningprimrose	E	CA	N	Y
Oenothera deltoides howellii	Antioch Dunes eveningprimrose	E	CA	Y	Y
Opuntia treleasei	Bakersfield cactus	E	CA	N	Y
Orcuttia californica	California orcutt grass	E	CA	N	Y
Orcuttia inaequalis	San Joaquin orcutt grass	T	CA	Y	Y
Orcuttia pilosa	Hairy orcutt grass	E	CA	Y	Y
Orcuttia tenuis	Slender orcutt grass	T	CA	Y	Y
Orcuttia viscida	Sacramento orcutt grass	E	CA	Y	Y
Oxytheca parishii var. goodmaniana	Cushenbury oxytheca	E	CA	Y	Y
Parvisedum leiocarpum	Lake County stonecrop	E	CA	N	Y
Pediocactus bradyi	Brady pincushion cactus	E	AZ	N	Y
Pediocactus despainii	San Rafael cactus	E	UT	N	Y
Pediocactus knowltonii	Knowlton cactus	E	CO, NM	N	Y
Pediocactus peeblesianus peeblesianus	Peebles Navajo cactus	E	AZ	N	Y
Pediocactus peeblesianus fickeiseniae	Fickeisen plains cactus	C	AZ	N	N
Pediocactus sileri	Siler pincushion cactus	T	AZ, UT	N	Y
Pediocactus winkleri	Winkler cactus	T	UT	N	Y
Penstemon debilis	Parachute beardtongue	C	CO	N	N
Penstemon penlandii	Penland beardtongue	E	CO	N	Y
Penstemon scariosus albifluvis	White River beardtongue	C	CO, UT	N	N
Pentachaeta bellidiflora	White-rayed pentachaeta	E	CA	N	Y
Pentachaeta lyonii	Lyon’s pentachaeta	E	CA	Y	Y
Phacelia argillacea	Clay phacelia	E	UT	N	Y
Phacelia formosula	North Park phacelia	E	CO	N	Y
Phacelia stellaris	Brand’s phacelia	C	CA	N	N
Phacelia submutica	Debeque phacelia	E	CO	N	N
Phlox hirsuta	Yreka phlox	E	CA	N	Y
Physaria obcordata	Dudley Bluffs twinpod	T	CO	N	Y
Physaria tuplashensis	White Bluffs bladderpod	C	WA	N	N
Piperia yadonii	Yadon’s piperia	E	CA	N	Y
Plagiobothrys hirtus	Rough popcornflower	E	OR	N	Y
Plagiobothrys strictus	Calistoga allocarya	E	CA	N	N
Poa atropurpurea	San Bernardino bluegrass	E	CA	N	N
Poa napensis	Napa bluegrass	E	CA	N	N
Pogogyne abramsii	San Diego mesa-mint	E	CA	N	Y
Pogogyne nudiuscula	Otay mesa-mint	E	CA	N	Y
Polygonum hickmanii	Scotts Valley polygonum	E	CA	Y	N
Polystichum aleuticum	Aleutian shield fern	E	AK	N	Y
Potentilla basaltica	Soldier Meadows cinquefoil	C	NV	N	N

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Potentilla hickmanii	Hickman's potentilla	E	CA	N	Y
Primula maguirei	Maguire primrose	T	UT	N	Y
Pseudobahia bahiifolia	Hartweg's golden sunburst	E	CA	N	N
Pseudobahia peirsonii	San Joaquin adobe sunburst	T	CA	N	N
Purshia subintegra	Arizona cliff-rose	E	AZ	N	Y
Ranunculus aestivalis	Autumn buttercup	E	UT	N	Y
Rorippa gambellii	Gambel's watercress	E	CA	N	Y
Rorippa subumbellata	Tahoe yellow cress	C	CA, NV	N	N
Schoenocrambe argillacea	Clay reed-mustard	T	UT	N	Y
Schoenocrambe barnebyi	Barneby reed-mustard	E	UT	N	Y
Schoenocrambe suffrutescens	Shrubby reed-mustard	E	Y	N	Y
Sclerocactus glaucus	Uinta Basin hookless cactus	T	CO, UT	N	Y
Sclerocactus mesae-verdae	Mesa Verde cactus	T	CO,UT	N	Y
Sclerocactus wrightiae	Wright fishhook cactus	E	UT	N	Y
Sedum eastwoodiae	Red Mountain stonecrop	C	CA	N	N
Senecio franciscanus	San Francisco Peaks groundsel	T	AZ	Y	Y
Senecio layneae	Layne's butterweed	T	CA	N	Y
Sidalcea keckii	Keck's checker-mallow	E	CA	Y	N
Sidalcea nelsoniana	Nelson's checker-mallow	T	OR, WA	N	Y
Sidalcea oregana valida	Kenwood marsh checkermallow	E	CA	N	N
Sidalcea oregana var. calva	Wenatchee Mountains checker-mallow	E	WA	Y	Y
Sidalcea pedata	Pedate checker-mallow	E	CA	N	Y
Silene spaldingii	Spalding's catchfly	T	ID, MT, OR, WA	N	Y
Spiranthes delitescens	Canelo hills ladies'-tresses	E	AZ	N	N
Spiranthes diluvialis	Ute ladies'-tresses	T	CO, ID, MT, NV, UT, WA, WY	N	Y
Stephanomeria malheurensis	Malheur wire-lettuce	E	OR	Y	Y
Streptanthus albidus albidus	Metcalf Canyon jewelflower	E	CA	N	Y
Streptanthus niger	Tiburon jewelflower	E	CA	N	Y
Suaeda californica	California seablite	E	CA	N	N
Swallenia alexandrae	Eureka dune grass	E	CA	N	Y
Taraxacum californicum	California taraxacum	E	CA	N	N
Thelypodium howellii spectabilis	Howell's spectacular thelypody	T	OR	N	Y
Thelypodium stenopetalum	Slender-petaled mustard	E	CA	N	Y
Thlaspi californicum	Kneeland Prairie pennycress	E	CA	Y	Y
Townsendia aprica	Last chance townsendia	T	UT	N	Y
Trichostema austromontanum compactum	Hidden Lake bluecurls	T	CA	N	N
Trifolium amoenum	Showy Indian clover	E	CA	N	N
Trifolium trichocalyx	Monterey clover	E	CA	N	Y
Tuctoria greenei	Greene's tuctoria	E	CA	Y	Y
Tuctoria mucronata	Solano grass	E	CA	Y	Y

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Verbena californica	Red Hills vervain	T	CA	N	N
Verbesina dissita	Big-leaved crownbeard	T	CA	N	N
Yermo xanthocephalus	Desert yellowhead	T	WY	Y	N
Invertebrates					
Ambrysus amargosus	Ash Meadows naucorid	T	NV	Y	Y
Ambrysus funebris	Nevares Spring naucorid bug	C	CA	N	N
Apodemia mormo langei	Lange's metalmark butterfly	E	CA	N	Y
Assiminea pecos	Pecos assiminea snail	E	NM	Y	N
Boloria acrocnema	Uncompahgre fritillary butterfly	E	CO	N	Y
Branchinecta conservatio	Conservancy fairy shrimp	E	CA	Y	Y
Branchinecta longiantenna	Longhorn fairy shrimp	E	CA	Y	Y
Branchinecta lynchi	Vernal pool fairy shrimp	T	CA, OR	Y	Y
Branchinecta sandiegonensis	San Diego fairy shrimp	E	CA	Y	Y
Callophrys mossii bayensis	San Bruno elfin butterfly	E	CA	N	Y
Cicindela limbata albissima	Coral pink sand dunes tiger beetle	C	UT	N	N
Cicindela ohlone	Ohlone tiger beetle	E	CA	N	N
Desmocerus californicus dimorphus	Valley elderberry longhorn beetle	T	CA	Y	Y
Elaphrus viridis	Delta green ground beetle	T	CA	Y	Y
Euphilotes battoides allyni	El Segundo blue butterfly	E	CA	N	Y
Euphilotes enoptes smithi	Smith's blue butterfly	E	CA	N	Y
Euphydryas editha bayensis	Bay checkerspot butterfly	T	CA	Y	Y
Euphydryas editha quino	Quino checkerspot butterfly	E	CA	Y	Y
Euphydryas editha taylori	Taylor's checkerspot	C	OR, WA	N	N
Euproserpinus euterpe	Kern primrose sphinx moth	T	CA	N	Y
Gammarus desperatus	Noel's amphipod	E	NM	N	N
Glaucopsyche lygdamus palosverdesensis	Palos Verdes blue butterfly	E	CA	Y	Y
Haliotis sorenseni	White abalone	E	CA	N	N
Helminthoglypta walkeriana	Morro shoulderband snail	E	CA	Y	Y
Hesperia leonardus montana	Pawnee montane skipper	T	CO	N	Y
Heterelmis stephani	Stephan's riffle beetle	C	AZ	N	N
Icaricia icarioides fenderi	Fender's blue butterfly	E	OR	N	N
Icaricia icarioides missionensis	Mission blue butterfly	E	CA	N	Y
Juturnia kosteri	Koster's springsnail	E	NM	N	N
Lanx sp.	Banbury springs limpet	E	ID	N	Y
Lepidurus packardi	Vernal pool tadpole shrimp	E	CA	Y	Y
Lycaeides argyrognomon lotis	Lotis blue butterfly	E	CA	N	Y
Oreohelix peripherica wasatchensis	Ogden mountainsnail	C	UT	N	N
Oxyloma haydeni kanabensis	Kanab ambersnail	E	AZ, UT	N	Y
Pacifastacus fortis	Shasta crayfish	E	CA	N	Y
Physa natricina	Snake River physa snail	E	ID	N	Y
Polites mardon	Mardon skipper	C	CA, OR, WA	N	N
Polyphylla barbata	Mount Hermon june beetle	E	CA	N	Y
Popenaias popei	Texas hornshell	C	NM	N	N

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Pseudocopaeodes eunus obscurus	Carson wandering skipper	E	CA, NV	N	Y
Pyrgulopsis bernardina	San Bernardino springsnail	C	AZ	N	N
Pyrgulopsis bruneauensis	Bruneau hot springsnail	E	ID	N	Y
Pyrgulopsis chupaderae	Chupadera springsnail	C	NM	N	N
Pyrgulopsis gilae	Gila springsnail	C	NM	N	N
Pyrgulopsis idahoensis	Idaho springsnail	E	ID	N	Y
Pyrgulopsis morrisoni	Page springsnail	C	AZ	N	N
Pyrgulopsis neomexicana	Socorro springsnail	E	NM	N	Y
Pyrgulopsis roswellensis	Roswell springsnail	E	NM	N	N
Pyrgulopsis thermalis	New Mexico springsnail	C	NM	N	N
Pyrgulopsis thompsoni	Huachuca springsnail	C	AZ	N	N
Pyrgulopsis trivialis	Three Forks springsnail	C	AZ	N	N
Pyrgus ruralis lagunae	Laguna Mountains skipper	E	CA	Y	N
Rhaphiomidas terminatus abdominalis	Delhi sands flower-loving fly	E	CA	N	Y
Speyeria callippe callippe	Callippe silverspot butterfly	E	CA	N	N
Speyeria zerene behrensii	Behren's silverspot butterfly	E	CA	N	Y
Speyeria zerene hippolyta	Oregon silverspot butterfly	T	CA, OR, WA	Y	Y
Speyeria zerene myrtleae	El Segundo blue butterfly	E	CA	N	Y
Stagnicola bonnevillensis	Bonneville pondsnail	C	UT	N	N
Streptocephalus woottoni	Riverside fairy shrimp	E	CA	Y	Y
Syncaris pacifica	California freshwater shrimp	E	CA	N	Y
Taylorconcha serpenticola	Bliss rapids snail	T	ID	N	Y
Thermosphaeroma thermophilus	Socorro isopod	E	NM	N	Y
Trimerotropis infantilis	Zayante band-winged grasshopper	E	CA	Y	Y
Tryonia alamosae	Alamosa springsnail	E	NM	N	Y
Valvata utahensis	Utah valvata snail	E	ID	N	Y
Fish					
Acipenser transmontanus	White sturgeon	E	ID, MT	Y	Y
Catostomus discobolus yarrowi	Zuni bluehead sucker	C	AZ, NM	N	N
Catostomus microps	Modoc sucker	E	CA	Y	Y
Catostomus santaanae	Santa Ana sucker	T	CA	Y	N
Catostomus warnerensis	Warner sucker	E	OR	Y	Y
Chasmistes brevirostris	Shortnose sucker	E	CA, OR	N	Y
Chasmistes cujus	Cui-ui	E	NV	N	Y
Chasmistes liorus	June sucker	E	UT	Y	Y
Crenichthys baileyi baileyi	White River springfish	E	NV	Y	Y
Crenichthys baileyi grandis	Hiko White River springfish	E	NV	Y	Y
Crenichthys nevadae	Railroad Valley springfish	T	NV	Y	Y
Cyprinella formosa	Beautiful shiner	T	AZ, NM	Y	Y
Cyprinodon diabolis	Devils Hole pupfish	E	NV	Y	Y
Cyprinodon macularius	Desert pupfish	E	AZ, CA	Y	Y
Cyprinodon nevadensis mionectes	Ash Meadows amargosa pupfish	E	NV	Y	Y
Cyprinodon nevadensis pectoralis	Warm Springs pupfish	E	NV	N	Y

Scientific Name	Common Name	Listing Status[a]	State in which Species could Occur	Designated Critical Habitat	Recovery Plan
Cyprinodon radiosus	Owens pupfish	E	CA	N	Y
Deltistes luxatus	Lost River sucker	E	CA, OR	N	Y
Empetrichthys latos	Pahrump poolfish	E	NV	N	Y
Eremichthys acros	Desert dace	T	NV	Y	Y
Etheostoma cragini	Arkansas darter	C	CO	N	N
Eucyclogobius newberryi	Tidewater goby	E	CA	Y	Y
Gambusia nobilis	Pecos gambusia	E	NM	N	Y
Gasterosteus aculeatus williamsoni	Unarmored threespine stickleback	E	CA	N	Y
Gila bicolor mohavensis	Mohave tui chub	E	CA	N	Y
Gila bicolor snyderi	Owens tui chub	E	CA	Y	Y
Gila bicolor ssp.	Hutton tui chub	T	OR	N	Y
Gila boraxobius	Borax Lake chub	E	OR	Y	Y
Gila cypha	Humpback chub	E	AZ, CO, UT, WY	Y	Y
Gila ditaenia	Sonora chub	T	AZ	Y	Y
Gila elegans	Bonytail chub	E	AZ, CA, CO, NV, UT, WY	Y	Y
Gila intermedia	Gila chub	E	AZ, NM	Y	N
Gila nigra	Headwater chub	C	AZ, NM	N	N
Gila nigrescens	Chihuahua chub	T	NM	N	Y
Gila purpurea	Yaqui chub	E	AZ	Y	Y
Gila robusta jordani	Pahranagat roundtail chub	E	NV	N	Y
Gila seminuda	Virgin River chub	E	AZ, NV, UT	Y	Y
Hybognathus amarus	Rio Grande silvery minnow	E	NM	Y	Y
Hypomesus transpacificus	Delta smelt	T	CA	Y	Y
Ictalurus pricei	Yaqui catfish	T	AZ	Y	Y
Lepidomeda albivallis	White River spinedace	E	NV	Y	Y
Lepidomeda mollispinis pratensis	Big Spring spinedace	T	NV	Y	Y
Lepidomeda vittata	Little Colorado spinedace	T	AZ	Y	Y
Meda fulgida	Spikedace	T	AZ, NM	Y	Y
Moapa coriacea	Moapa dace	E	NV	Y	Y
Notropis girardi	Arkansas River shiner	T	NM	Y	N
Notropis simus pecosensis	Pecos bluntnose shiner	T	NM	Y	Y
Oncorhynchus aguabonita whitei	Little Kern golden trout	T	CA	Y	Y
Oncorhynchus apache	Apache trout	T	AZ	N	Y
Oncorhynchus clarkii henshawi	Lahontan cutthroat trout	T	CA, NV, OR, UT	N	Y
Oncorhynchus clarkii seleniris	Paiute cutthroat trout	T	CA	N	Y
Oncorhynchus clarkii stomias	Greenback cutthroat trout	T	CO	N	Y
Oncorhynchus gilae	Gila trout	T	AZ, NM	N	Y
Oncorhynchus keta	Chum salmon[b]	T	OR	Y	N
Oncorhynchus kisutch	Coho salmon[b]	PT, T[c], E[c]	CA, OR, WA	Y	N

Scientific Name	Common Name	Listing Status[a]	State in which Species could Occur	Designated Critical Habitat	Recovery Plan
Oncorhynchus mykiss	Steelhead[b]	T[c], E[c]	CA, ID, OR, WA	Y	N
Oncorhynchus nerka	Sockeye salmon[b]	E	ID, WA	Y	N
Oncorhynchus tshawytscha	Chinook salmon[b]	T[c], E[c]	CA, OR, WA	Y	N
Oregonichthys crameri	Oregon chub	E	OR	N	Y
Plagopterus argentissimus	Woundfin	E	AZ, UT	Y	Y
Poeciliopsis occidentalis	Gila topminnow	E	AZ, NM	N	Y
Ptychocheilus lucius	Colorado pikeminnow	E	AZ, CA, CO, NM, NV, UT, WY	Y	Y
Rhinichthys osculus lethoporus	Independence Valley speckled dace	E	NV	N	Y
Rhinichthys osculus nevadensis	Ash Meadows speckled dace	E	NV	Y	Y
Rhinichthys osculus oligoporus	Clover Valley speckled dace	E	NV	N	Y
Rhinichthys osculus ssp.	Foskett speckled dace	T	OR	N	Y
Rhinichthys osculus thermalis	Kendall Warm Springs dace	E	WY	N	Y
Salvelinus confluentus	Bull trout	T	ID, MT, NV, OR, WA	Y	Y
Scaphirhynchus albus	Pallid sturgeon	E	MT	N	Y
Thymallus arcticus	Fluvial Arctic grayling	C	MT, WY	N	N
Tiaroga cobitis	Loach minnow	T	AZ, NM	Y	Y
Xyrauchen texanus	Razorback sucker	E	AZ, CA, CO, NM, NV, UT, WY	Y	Y
Amphibians					
Ambystoma californiense	California tiger salamander	T[c], E[c]	CA	T	N
Ambystoma tigrinum stebbinsi	Sonora tiger salamander	E	AZ	Y	Y
Batrachoseps aridus	Desert slender salamander	E	CA	N	Y
Bufo baxteri	Wyoming toad	E	WY	N	Y
Bufo californicus	Arroyo toad	E	CA	Y	Y
Bufo canorus	Yosemite toad	C	CA	N	N
Rana aurora draytonii	California red-legged frog	T	CA	Y	Y
Rana chiricahuensis	Chiricahua leopard frog	T	AZ, NM	N	Y
Rana luteiventris	Columbia Spotted frog	C	NV	N	N
Rana muscosa	Mountain yellow-legged frog	E[c], C[c]	CA, NV	Y	N
Rana onca	Relict leopard frog	C	AZ, NV, UT	N	N
Rana pretiosa	Oregon spotted frog	C	CA, OR, WA	N	N
Hyla wrightorum	Arizona treefrog[b]	C	AZ	N	N
Reptiles					

Scientific Name	Common Name	Listing Status[a]	State in which Species could Occur	Designated Critical Habitat	Recovery Plan
Crotalus willardi obscurus	New Mexican ridge-nosed rattlesnake	T	AZ, NM	Y	Y
Gambelia silus	Blunt-nosed leopard lizard	E	CA	N	Y
Gopherus agassizii	Desert tortoise	T	AZ, CA, NV, UT	Y	Y
Kinosternon sonoriense longifemorale	Sonoyta mud turtle	C	AZ	N	N
Masticophis lateralis euryxanthus	Alameda whipsnake	T	CA	Y	Y
Sceloporus arenicolus	Sand dune lizard	C	NM	N	N
Thamnophis gigas	Giant garter snake	T	CA	N	Y
Thamnophis sirtalis tetrataenia	San Francisco garter snake	E	CA	N	Y
Uma inornata	Coachella Valley fringe-toed lizard	T	CA	Y	Y
Mammals					
Antilocapra americana sonoriensis	Sonoran pronghorn	E	AZ	N	N
Aplodontia rufa nigra	Point Arena mountain beaver	E	CA	N	N
Brachylagus idahoensis	Pygmy rabbit	E	OR, WA	N	N
Canis lupus	Gray wolf	E	AZ, CO, ID, MT, NM, NV, OR, UT, WA, WY	Y	Y
Cynomys parvidens	Utah prairie dog	T	UT	N	Y
Dipodomys heermanni morroensis	Morro Bay kangaroo rat	E	CA	Y	Y
Dipodomys ingens	Giant kangaroo rat	E	CA	N	Y
Dipodomys merriami parvus	San Bernardino Merriam's kangaroo rat	E	CA	Y	N
Dipodomys nitratoides exilis	Fresno kangaroo rat	E	CA	Y	Y
Dipodomys nitratoides nitratoides	Tipton kangaroo rat	E	CA	B	Y
Dipodomys stephensi	Stephens' kangaroo rat	E	CA	N	Y
Herpailurus yagouaroundi tolteca	Sinaloan jaguarundi	E	AZ	N	Y
Leopardus pardalis	Ocelot	E	AZ	N	Y
Leptonycteris curasoae yerbabuenae	Lesser long-nosed bat	E	AZ, NM	N	Y
Leptonycteris nivalis	Mexican long-nosed bat	E	NM	N	Y
Lynx canadensis	Canada lynx	T	AK, CO, ID, OR, UT, WA, WY	Y	N
Martes pennanti	West coast fisher	C	CA, OR, WA	N	Y
Microtus californicus scirpensis	Amargosa vole	E	CA	N	Y
Microtus mexicanus hualpaiensis	Hualapai Mexican vole	E	AZ	N	Y
Mustela nigripes	Black-footed ferret	E	AZ, CO, MT, UT, WY	N	Y
Neotoma fuscipes riparia	Riparian woodrat	E	CA	N	Y
Odocoileus virginianus leucurus	Columbian white-tailed deer	E	OR, WA	N	Y

Scientific Name	Common Name	Listing Status[a]	State in which Species could Occur	Designated Critical Habitat	Recovery Plan
Ovis canadensis	Peninsular bighorn sheep	E	CA	Y	Y
Ovis canadensis californiana	Sierra Nevada bighorn sheep	E	CA	N	Y
Panthera onca	Jaguar	E	AZ, NM	N	Y
Perognathus longimembris pacificus	Pacific pocket mouse	E	CA	N	Y
Rangifer tarandus caribou	Woodland caribou	E	ID, WA	N	Y
Reithrodontomys raviventris	Salt marsh harvest mouse	E	CA	N	Y
Sorex ornatus relictus	Buena Vista Lake ornate shrew	E	CA	Y	Y
Spermophilus brunneus brunneus	Northern Idaho ground squirrel	T	ID	N	Y
Spermophilus brunneus endemicus	Southern Idaho ground squirrel	C	ID	N	N
Spermophilus tereticaudus chlorus	Palm Springs round-tailed ground squirrel	C	CA	N	N
Spermophilus washingtoni	Washington ground squirrel	C	OR, WA	N	N
Sylvilagus bachmani riparius	Riparian brush rabbit	E	CA	N	Y
Tamiasciurus hudsonicus grahamensis	Mount Graham red squirrel	E	AZ	Y	Y
Thomomys mazama glacialis	Roy Prairie pocket gopher	C	WA	N	N
Thomomys mazama louiei	Louie's western pocket gopher	C	WA	N	N
Thomomys mazama melanops	Olympic pocket gopher	C	WA	N	N
Thomomys mazama pugetensis	Olympia pocket gopher	C	WA	N	N
Thomomys mazama couchi	Shelton pocket gopher	C	WA	N	N
Thomomys mazama tacomensis	Tacoma western pocket gopher	C	WA	N	N
Thomomys mazama tumuli	Tenino pocket gopher	C	WA	N	N
Thomomys mazama yelmensis	Yelm pocket gopher	C	WA	N	N
Ursus arctos horribilis	Grizzly bear	T[d]	ID, MT, NM, NV, OR, UT, WA, WY	N	Y
Vulpes macrotis mutica	San Joaquin kit fox	E	CA	N	Y
Zapus hudsonius preblei	Preble's meadow jumping mouse	T	CO, WY	Y	N
Zapus hudsonius luteus	New Mexico meadow jumping mouse	C	AZ, NM	N	N
Birds					
Brachyramphus brevirostris	Kittlitz's murrelet	C	AK	N	N
Brachyramphus marmoratus	Marbled murrelet	T	CA, OR, WA	Y	Y
Centrocercus urophasianus	Greater sage-grouse	C	OR, WA	N	N
Charadrius alexandrinus nivosus	Western snowy plover	T	CA, OR, WA	Y	Y
Charadrius melodus	Piping plover	T	CO, MT	Y	Y
Coccyzus americanus	Western yellow-billed cuckoo	C	AZ, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY	N	N

Scientific Name	Common Name	Listing Status[a]	State in which Species could Occur	Designated Critical Habitat	Recovery Plan
Colinus virginianus ridgwayi	Masked bobwhite	E	AZ	N	Y
Empidonax traillii extimus	Southwestern willow flycatcher	E	AZ, CA, CO, NM, UT	Y	Y
Eremophila alpestris strigata	Streaked horned lark	C	OR, WA	N	N
Falco femoralis septentrionalis	Northern Aplomado falcon	E	NM	N	Y
Grus americana	Whooping crane	E	CO, MT	Y	Y
Gymnogyps californianus	California condor	E	AZ, CA, UT	Y	Y
Numenius borealis	Eskimo curlew	E	AK, MT, NM, NV, OR, UT, WA, WY	N	N
Phoebastria (=Diomedea) albatrus)	Short-tailed albatross	E	AK	N	Y
Pipilo crissalis eremophilus	Inyo California towhee	T	CA	Y	Y
Polioptila californica californica	Coastal California gnatcatcher	T	CA	Y	N
Rallus longirostris levipes	Light-footed clapper rail	E	CA	N	Y
Rallus longirostris obsoletus	California clapper rail	E	CA	N	Y
Rallus longirostris yumanensis	Yuma clapper rail	E	AZ, CA	N	Y
Polysticta stelleri	Steller's Eiderb	T[c]	AK	Y	Y
Somateria fischeri	Spectacled Eider	T	AK	Y	Y
Sterna antillarum	Interior least tern	E	CO, MT, NM	N	Y
Sterna antillarum browni	California least tern	E	CA	N	Y
Strix occidentalis caurina	Northern spotted owl	T	CA, OR, WA	Y	Y
Strix occidentalis lucida	Mexican spotted owl	T	AZ, CO, NM, UT	Y	Y
Synthliboramphus hypoleucus	Xantus's murrelet	C	CA	N	N
Tympanuchus pallidicinctus	Lesser prairie-chicken	C	CO, NM	N	N
Vireo bellii pusillus	Least Bell's vireo	E	CA	Y	Y

[a] C = candidate for listing, E = listed as endangered, PT = proposed for listing as threatened, T = listed as threatened.

[b] Includes one or more "evolutionarily significant units" that spawn in different river basins or at different times of year and that have been assigned separate listing status.

[c] More than one listing category indicates that the species has different status in different states.

[d] Grizzley bears in the Yellowstone District Population Segment in Idaho, Montana, and Wyoming are considered recovered and have been delisted.

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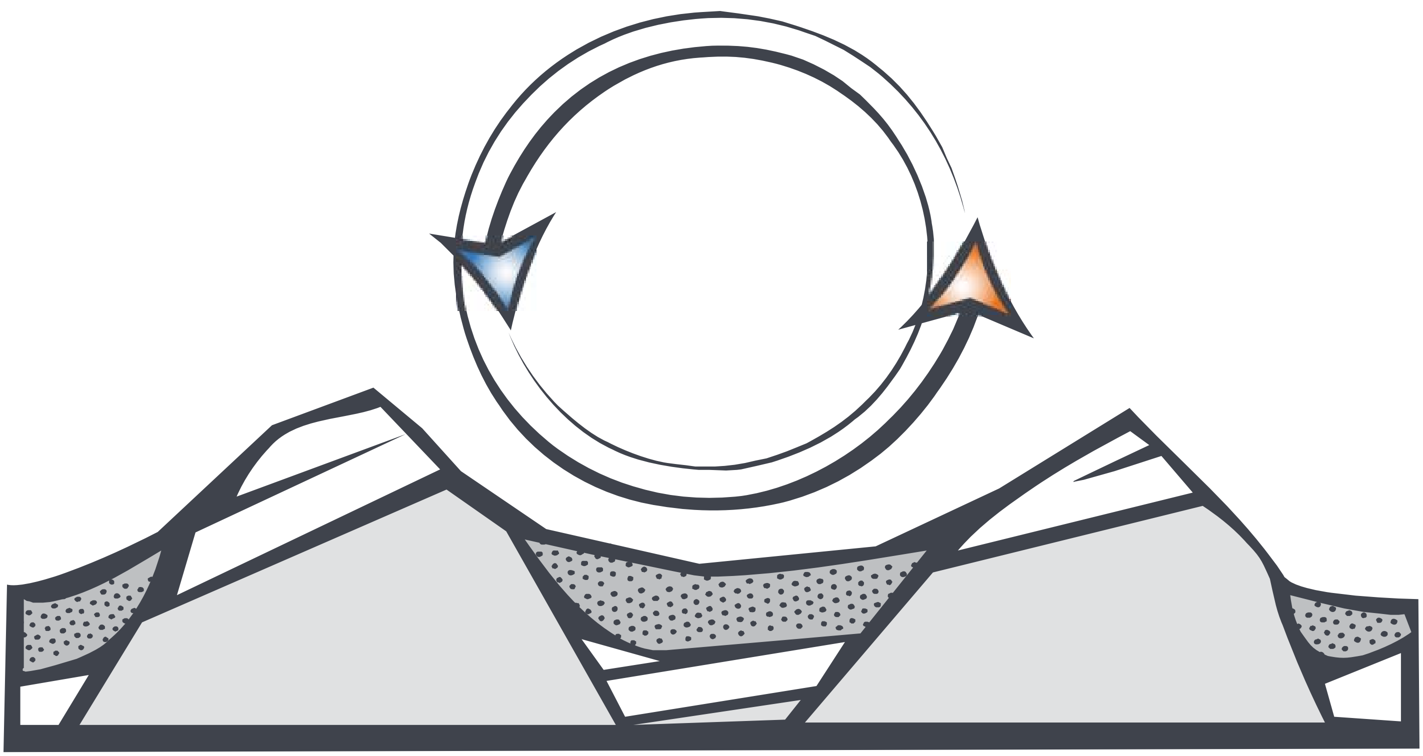

Appendix I

Cultural Resources Regional Ethnohistory

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APPENDIX I
CULTURAL RESOURCE REGIONAL ETHNOHISTORY

Cultural resources are past and present expressions of human culture and history in the physical environment and include prehistoric and historic archaeological sites, structures, natural features, and biota which are considered important to a culture, subculture, or community. Cultural resources also include aspects of the physical environment that are a part of traditional lifeways and practices, and are associated with community values and institutions. These traditional cultural resources are addressed in a separate chapter on ethnographic resources and tribal trust assets (Chapter 3.15). Cultural resources addressed here include the physical remains of prehistoric and historic cultures and activities, such as archaeological sites, historic trails, and boom towns. Historic properties are a subset of these kinds of cultural resources that meet specific eligibility criteria found at 36 CFR 60.4 for listing on the National Register of Historic Places (NRHP).

In this chapter, cultural resources have been organized into prehistoric and historic resources. Further, they are discussed according to established culture regions: Alaska, Northwest Coast, Plateau, Great Basin, Great Plains, California, and Southwest. These are regions where there is continuity across the landscape in cultural adaptations and traditions. For consistency, maps defining these regions and the cultural groups within them are derived from the respective volumes of the Smithsonian Handbook of the American Indian and reflect the choices of the authors and editors of this series. These maps are generally depict territorial assumptions existing at the approximate time of Native contact with Euro-Americans and may not encompass territorial ranges or ancestral lands as recognized by tribes or archaeologists. For example, important Ancestral Puebloan occupations in Southwestern Colorado are found outside of the tribal ranges for the Southwest region. This is a programmatic level overview and should not be considered a detailed source for the extent of regional cultural influence or tribal interest.

Culture resources of these regions have been organized into prehistoric and historic resources. Prehistoric resources refer to any material remains, structures, and items used or modified by people before Euro- Americans established a presence in the region. Historic resources include material remains and the landscape alterations that have occurred since the arrival of Euro-Americans.

Discussions of prehistory within each region are focused on chronological periods that have been established based on the prehistoric archaeology of the region. It should be noted that for many of these regions there are area-specific culture chronologies that have been developed where cultural practices were unique within the larger region. Discussion of such specific time periods is avoided here given the programmatic nature of this document and for ease of discussion. Discussions of the history within each region are organized by overall themes of the region. This includes such things as westward expansion, transportation, and mineral development. Since this approach leads to a very general discussion of the culture regions, an effort was made to work with the USFS and BLM regional and district offices within the project area to identify areas sensitive for cultural resources.

Overviews by Region

Alaska (Arctic and Subarctic)

Alaska is divided into two culture regions, the Arctic and Subarctic, which are combined into the Alaska culture region for purposes of discussion here (Figure 3-15). The physiographic boundary between the two culture regions is essentially the tree-line (Damas 1984a; Neusius and Gross 2007). Culturally, the boundary is defined by areas occupied by the Inuit or Eskimo and the Aleut and those areas occupied by other Native American groups. Within the project area, the Arctic extends from the Yukatat Bay along the Alaska coast to the Bering Sea and includes the coast and adjacent tundra of the Yukon. Note that the portion of Alaska south of Yukatat Bay is considered part of the Northwest Coast culture region. The Aleutian Islands are included in the Arctic culture region as well. The Subarctic culture region is inland from the Arctic and encompasses interior Alaska (Damas 1984a; Helm 1981a; Neusius and Gross 2007). The southern boundary is marked by the boundary between the boreal forest and mixed deciduous-coniferous forests (Helm 1981a). The Arctic and Subarctic regions also include areas of Canada, Nunavut, and Greenland (Damas 1984a; Helm 1981a; Neusius and Gross 2007). However, since these areas are outside of the project area they are not discussed here.

USFS regions in the Alaska culture region include most of Region 10. BLM District Offices included in the region include all or portions of the Fairbanks and Anchorage offices.

Table I-1 identifies the Alaska culture region languages and tribes that have been documented within the project area, as well as the specific culture region, Arctic or Subarctic, they are associated with. Culturally, the Alaska culture region considered here is bordered by the Northwest Coast to the south.

Table I-1
Languages and Tribes of the Alaska (Subarctic and Arctic) Culture Region in the Project Area

Language (Linguistic Phylum; Culture Region)	Tribes
Athapascan (Na-Dene; Subarctic)	Holikachuk, Ingalik, Kolchan, Tanaina, Koyukon, Kutchin, Tanana, Ahtna, Han
Eskimaleut (American Arctic/Paleo-Siberian; Arctic)	Pacific Eskimo, Aleut, Mainland Southwest Alaska Eskimo, Nunivak Eskimo, St. Lawrence Island Eskimo, Bering Strait Eskimo, Kotzebue Sound Eskimo, Interior North Alaska Eskimo, North Alaska Coast Eskimo, Mackenzie Delta Eskimo

Source: Damas 1984b; Helm 1981b; Waldman 2000

Although the standard Handbook of North American Indians for the Alaska culture regions (Damas 1984c; Helm 1981c) offer region-specific chronologies for the Arctic and Subarctic, a more generalized chronology relevant to cultural patterns found in Alaska, which encompasses only a small percentage of the overall regions, is used in this discussion. Much of Alaska was ice free during the last glacial period (Clark 1981; Neusius and Gross 2007) and one would expect to find the earliest evidence for people crossing the Bering land bridge from Asia to be found in western Alaska. However, Pre-Clovis evidence for occupation of Alaska is debatable and the early coastline has been greatly altered from rising sea levels. The earliest agreed upon evidence is for a microblade tradition in the Paleoindian Subarctic similar to that of the Archaic Northwest Coast. The following outlines a general chronology used here for the culture regions of Alaska (Neusius and Gross 2007). One will note that many of the cultural traditions outlined below occurred concurrently in different regions. Such cultural patterns were too highly varied to accommodate a single general cultural period and are thus addressed separately.

- Paleoarctic: pre-8000 BP
- Archaic: 8000 – 500 BP
- Northern/Central Alaska

- Northern Archaic Tradition: 8300 – 500 BP
- Arctic Small Tool Tradition: 4500 – 3000 BP
- Norton Tradition: 3000 – 1200 BP
- Thule Tradition: 2000 BP – Modern Times
- Pacific Coast Alaska
- Ocean Bay Tradition: 7000 – 4500 BP
- Kodiak Tradition: 4500 BP – Modern Times
- Aleutian Tradition: 5500 BP – Modern Times

The Historic period then follows the Archaic Period, but as one can see many of the Archaic cultural practices continue today with minor adaptations to modern influences.

CULTURAL HISTORY

Prehistoric

Paleoarctic: As discussed above the evidence for Pre-Clovis occupations in Alaska are ambiguous, particularly in the far northern areas. However it would be in western Alaska that we would expect to find the earliest evidence of human occupation of North America if peoples migrated to the area via the Bering Land Bridge. As such, the archaeology of the area is considered likely to provide important information pertaining to early North American human settlement (Neusius and Gross 2007). Fluted points have been found, but like other culture regions, these are typically found as isolated surface finds or in uncertain associations, many just east of the state line in Canada (Dumond 1984; Helm 1981; Neusius and Gross 2007); unlike other areas, it appears fluted points were made later in Alaska than they were to the south and have some technological differences. Although these points are not commonly found in direct association with bone of game in Alaska, blood residue analyses have indicated their use on such resources (Neusius and Gross 2007).

The earliest sites in Alaska are contemporaneous with Clovis sites found further south (Neusius and Gross 2007). The most confident of these early sites are comprised of stone tools and detritus (Dumond 1984). These are found western Alaska and are associated with the Nenana and Denali, dated to between 12,000 and 11,000 BP and between 11,000 and 8000 BP, respectively. The Nenana complex is a blade and biface industry, but is without microblades. Technology used to create Nenana tools is similar to that found in parts of the Southwest (Neusius and Gross 2007). The Denali complex is part of the Paleoarctic tradition seen elsewhere with inland hunters and includes microblades, wedge-shaped microblade cores, bifaces, and burins. Such toolkits are seen well into later periods of the region. It is believed that the microblade technologies are derived from Asia (Clark 1981; Neusius and Gross 2007).

Archaic: Archaic patterns in Alaska vary greatly across the region and differences between the Pacific Coast of Alaska and Interior Alaska begin to become more evident. In the northern and central regions of Alaska the Northern Archaic Tradition developed in the interior, giving way in some parts to the Arctic Small Tool Tradition and then the Norton and Thule Traditions. The first maritime adaptations are recognized along the Pacific coast in the Ocean Bay, Kodiak, and Aleutian Traditions. Throughout just about all of the Alaska region the Archaic persisted until historic times (Dumond 1984; Neusius and Gross 2007).

Central and Northern Alaska Traditions

The Northern Archaic Tradition (8000 – 500 BP) does not include microblades, but does include projectile points, bifacial tools, scrapers, and other lithic tools (Clark 1981; Dumond 1984; Neusius and Gross 2007). What little subsistence and settlement data there is would indicate that those practicing this tradition were generalized foragers who hunted on land and fished along rivers (Dumond 1984; Neusius and Gross 2007). Tracking these technologies across time and space has led researchers to believe that this tradition spread south and east following its development in interior Alaska. However, there is some indication that the tradition may have been the result of interaction with northern cultures of the Great Plains. Ultimately, the tradition appears to have been an antecedent to cultural practices of the Na-Dene or Athapaskan speakers of later times (Neusius and Gross 2007).

The Arctic Small Tool Tradition fully developed around 4000 and 3900 BP in northern Alaska midway through the Northern Archaic Tradition (Neusius and Gross 2007), ushering in a period of uniformity followed yet again by diversification of adaptations (Clark 1981; Damas 1984a). It is notably absent from the Aleutians and may have developed directly out of the Paleoarctic tradition of Siberia, migrating into Alaska. Originators of this tradition spread quickly throughout the Arctic and were the first to colonize the Arctic Ocean coast of North America, although the only known house sites are situated away from seacoast and toward the interior tundra. It is characterized blades that are smaller than those produced previously (Dumond 1984; Neusius and Gross 2007), as well as microblades, burins, adzes, oil lamps, as well as bone and antler tools (Clark 1981; Neusius and Gross 2007). Caribou hunting appears to have been the primary activity at sites of the Arctic Small Tool Tradition, but some on the Alaska Peninsula also appear to have been located so as to take advantage of salmon runs. In places where it remained, the tradition is believed to have continued until the Historic Period, appearing concurrently with other cultural traditions of the region (Neusius and Gross 2007).

In the western Arctic culture region the Norton Tradition developed and is dated to between 3000 and 1200 BP. Its tool assemblage is similar to that of the Arctic Small Tool Tradition, but incorporates ceramics. A series of three cultures, the Choris, Norton, and Ipiutak, characterize the Norton Tradition (Dumond 1984; Neusius and Gross 2007).

The Choris culture existed north of the Bering Strait between 3000 and 2500 BP and is characterized by new point styles resembling Paleoindian points of the Plains, chipped adze blades, burins, oval houses, and feather-tempered pottery. Technologies employed in Choris pottery appears to have been adopted from another region, most likely Asia, as a developed technology, as opposed to being locally invented (Dumond 1984; Neusius and Gross 2007).

The Norton complex appears around 2500 BP, apparently developing from the Choris complex. Occurring along the Alaska Peninsula and over to the northeastern border of the state and Canada, the Norton complex is characterized by caribou hunting, sealing, net fishing for salmon, and whale hunting as well as artifacts such as check-stamp design pottery, use of ceramic and stone lamps, end and side blades, knives, including some made of ground slate, burin-like tools, scrapers, and net sinkers (Dumond 1984; Neusius and Gross 2007).

The Ipiutak complex existed in northern Alaska above the Bering Strait and first appeared around 2000 BP, sharing several traits with the Choris and Norton complexes, but lacking lamps and pottery. The tradition is best known for its art, which incorporates elaborate carvings of animal and human figures, linked chains, and entangled objects. In addition to its art, the Ipiutak complex includes a variety of utilitarian objects such as harpoons, snow goggles, ground slate tools, and houses with entry ramps (Dumond 1984; Neusius and Gross 2007).

The Thule Tradition developed out of the Norton Tradition around 2000 BP and has continued through the Historic period (Dumond 1984; Neusius and Gross 2007). It covers several cultural complexes within Alaska. The tradition is likely best known for new hunting technologies to be used in open waters, especially for whaling (Neusius and Gross 2007). This is not to say though that the capabilities of Thule terrestrial hunters were not as sophisticated as those of marine and riverine hunters. In fact, the two skills were very well matched (Dumond 1984).

Early sites of the Thule Tradition are attributed to the Old Bering Sea and Okvik cultures (2200 – 1250 BP) of St. Lawrence and adjacent islands, as well as the Asian coast (Dumond 1984; Neusius and Gross 2007). The tradition is presumed to have developed about the same time the Ipiutak complex was developing on the mainland. Artifact forms of these Old Bering Sea and Okvik cultures are very similar and are only distinguished by their decorative art styles. The toolkit of these cultures in this part of the region included bone, antler, and ivory tools. Pottery was also used for cooking pots and lamps. Sea mammal hunting constituted the primary subsistence endeavor. It is thought that this was done from the ice edge, but was also likely done on open water with the use of harpoon lines and large open boats called *umiaks*. However, kayak artifacts and models provide evidence of the use of closed boats as well. Additionally, winter seal hunting is suggested by the presence of ice picks, fishing by the presence of hooks and spears, and the bow and arrow suggest terrestrial mammal hunting. Sleds were used to transport materials and kills; however, these were not the dog sleds commonly associated with Alaskan cultures (Neusius and Gross 2007).

The Birnirk culture developed in northern coasts of Alaska and spanned the same time period as the Old Bering Sea and Okvik cultures. Hunting activities and tools were similar to those of the more southern Alaska cultures, including use of kayaks and *umiaks*, but are distinguished by the use of flat toggling harpoon heads. Sleds were used for the same purposes and by the same means. Utilitarian pottery pieces, such as lamps, were marked with impressed circular designs. Houses were square with driftwood or whalebone above-ground walls, plank-lined floors, and sod-covered roofs (Neusius and Gross 2007).

From the Birnik culture developed the Thule culture which existed between 1050 BP and 400/250 BP. The complex of material culture attributed to this culture is also associated with the historic Eskimo and Inuit. Like the other cultures in the Thule Tradition, artifacts that characterize the Thule culture include bone, antler, and ivory tools, such as arrows, spears, and harpoon heads. However, in the Thule tradition the ratio of groundstone to other artifacts rose significantly to include about half of all stone tools found. Pottery was also used, but was tempered with gravel instead of the fibers used previously (Neusius and Gross 2007). The culture spread rapidly from northern Alaska across the Arctic, marked by the Sicco-type harpoon head, eventually reaching Greenland and once again displaying a cultural continuity for the majority of the Arctic culture region, similar to the Arctic Small Tool Tradition (Damas 1984a; Neusius and Gross 2007). The expansion was likely a result of people following bowhead whales. Dogsleds first appear with this culture, possibly as a result of open water hunting of bowheads which allowed for groups to amass large stores of food that would need to be transported back for storage at a settlement. In addition to whale hunting, seals, walruses, and birds were hunted from kayaks using *atlatls* and darts (Neusius and Gross 2007).

Pacific Coastal Alaska Traditions

The Ocean Bay Tradition (7000 – 4500 BP) is certainly present on Kodiak Island and possibly on the Alaskan Peninsula and Pacific Coast. It may be related to materials found on the Aleutian Islands. Ocean Bay sites are considered to be the earliest representations of maritime adaptations along the Alaska Pacific coast. It is notable for the use of tools made of ground slate, which were introduced into an assemblage dominated by flaked stone. The subsistence economy of peoples practicing this tradition was based on hunting of marine mammals and the pattern of site locations, situated on coastlines and near the ocean, is consistent with this activity (Neusius and Gross 2007).

The Kodiak and Aleutian Traditions developed out of the Ocean Bay Tradition around 4500 – 5000 BP and 5500 BP, respectively, and continued into modern times (Dumond 1984; Neusius and Gross 2007). The Aleutian Tradition developed west of the Kodiak Tradition. Ground slate tools are absent in this tradition, at least until very late in the period, around 500 BP. Instead flaked tools are primarily relied upon. The tradition does share the use of oil lamps and similar bone tools with the Kodiak Tradition. Sea mammal hunting appears to have been important given their commonality at sites, along with land mammals, marine invertebrates, fish, and migrating and resident birds. Aleutian Tradition sites are typically large middens along the coast that were inhabited on a semipermanent basis. Given the archaeological evidence, it is believed that the people practicing the Aleutian Tradition are the ancestors of the modern Aleuts (Neusius and Gross 2007).

As insinuated by its name, the Kodiak Tradition is centered on the Kodiak Island area and is characterized by the use ground slate, differentiating it from the Aleutian Tradition (Dumond 1984). It is separated into two stages: the Takli stage (4500 – 3500 BP) followed by the Kachemak stage (3500 – 1000 BP). In the Takli stage the toolkit included slate lance or dart points, formed initially by sawing, oil lamps, and chipped stone similar to that of the Ocean Bay Tradition. Subsistence activities focused on hunting land and sea mammals as well as fishing, and settlements are situated in areas conducive to these activities. In the Kachemak stage ground slate tools continue to be used, but are instead initially formed by chipping. In addition to slate tools, oil lamps continue to be present in sites as well as labrets of stone and bone. A variety of bone tools occur, including the toggling harpoon which improved the success of maritime hunting (Neusius and Gross 2007).

Historic

Historic continuity of earlier cultural practices is prevalent in Alaska (Clark 1981; Neusius and Gross 2007). In fact, through the 19th century, some Arctic groups had not yet had contact with Europeans (Neusius and Gross 2007). Russian exploration of the region led to the fur trade with historic Alaskan native peoples (Damas 1984; Neusius and Gross 2007) and Russian Orthodox missionaries followed. The effect of these missionaries was not as extensive as the effect of Spanish missionaries further south. As the whaling industry grew in the region and ships began wintering in the Arctic, contact between the native Alaskans and Europeans increased. This in turn led to increased trade and ultimately dependence on the fur trade to obtain European goods. Such adaptations are only one of a few historic changes in the native economies of Alaska (Neusius and Gross 2007). Mining and oil development by Europeans of the Alaskan interior began during the historic period and have continued to affect the cultures of the region into modern times (Helm 1981a; Neusius and Gross 2007).

Euro American Contact

Vitus Bering, a Danish sailor, was commissioned by Peter the Great, the Czar of Russia, in 1725 to explore the region that is present-day Alaska. Bering explored Greenland and the southwest coast, but did not explore present-day Alaska. His expeditions did heighten interest in the region because of the news he brought back to Europe of the wealth of furs and possibility of trading (Borneman 2003).

The Spanish were also interested in the region, partly out of concern that the Russians were going to settle that part of the continent. Spain also sent expeditions to the region but did not establish permanent settlement in Alaska (Borneman 2003).

The English were also early European explorers to the Alaska region. In 1776 Captain James Cook sailed the northwest coast of North America, mapping the inlet he discovered (named the Cook Inlet by George Vancouver) (Borneman 2003).

The first European settlement in Alaska was the Russian-American Company, established in 1784. The company was at the center of fur trade in Alaska, even though however the Russians never fully colonized the region.

Trade

Fur trade. Fur trapping and trading was one of the primary reasons Europeans were attracted to the region. The French, British, and Russians were all part of the fur trade in Alaska. The Hudson Bay Company and the Northwest Company had fur trading posts throughout Alaska, which lasted from the 1720s until it dwindled in the 1850s because of a diminishing animal populations (Neusius and Gross 2007; Borneman 2003).

Commercial Whaling and Fishing. Shore-based Eskimo whaling was long a tradition in coastal communities. Eskimo whalers were limited to taking whales near their villages when the animals migrated past on their annual round. Because of the huge quantity of meat and oil that successful whale hunting provided to a coastal village as well as the danger involved in a whale's pursuit, whaling and whalers had special significance for such communities. Ship-based whaling flourished during the 17th-19th centuries. Scandinavian, Dutch, English, Scottish, Russian and American whale fleets pursued the whales in the 19th century. Oil reduced from blubber and baleen were the primary commodities produced by this worldwide whaling industry (National Science Foundation 2007).

Salmon fishing was a mainstay to the Alaskan economy, with the first commercial salmon cannery built in 1878. Canneries were built throughout the southeast portion of Alaska, as well as in Cook Inlet and Bristol Bay (Borneman 2003). Salteries, which processed the salmon, packed and imported it in barrels, were also established. By 1911, the salmon population in Alaska was reduced, but by the 1920s, fishing was still considered the bedrock of the Alaskan economy (Borneman 2003). Commercial fishing continues to be an important part of the local economy.

Missionaries. Russian Orthodox missionaries followed the fur explorers and traders to the region during the 1740s-1780s. They were most successful in southern Alaska, and their activities lasted into the 1800s (Neusius and Gross 2007).

Gold Mining. Although gold was first discovered in 1850 on the Kenai Peninsula by a Russian mining engineer, the discovery was not widely publicized (Borneman 2003). In 1897, the Klondike River was the site of another gold discovery which led to a major gold rush into eastern Alaska and the Yukon Territory. Many settlers and gold miners came to the area, establishing trails or sailing routes in order to reach the area. The gold boom also struck in other parts of Alaska, such as Fairbanks and Nome (Borneman 2003). Other minerals, such as copper and molybdenum were mined as well.

Oil. Oil was claimed in Alaska on the Iniskin peninsula in the 1890s. In 1898, the first Alaska wells drilled oil there, however there was not enough to support a full-scale, long-term production of oil (Alaska History and Cultural Studies 2008).

The first productive drilling of oil occurred at Katalla, just south of the Copper River Delta. In 1911, new wells in the area began to produce a significant amount of oil, which was recovered then processed at a refinery at Katalla. The cost of transportation and operating costs were high, but the yield of oil proved worthwhile. In the 1960s, oil companies bought exploration leases for work in the Cook Inlet and production of oil began (Alaska History and Cultural Studies 2008). Oil exploration, production and transportation continues to be the most important industry in Alaska.

Trans-Alaska Pipeline System. The system began in 1968 as a joint venture between British Petroleum, Atlantic Richfield, and Humble. It was completed in 1977 and is an 800-mile pipeline that transports oil from Prudhoe Bay south to Hickel Highway, across the Yukon and to Livengood and Fairbanks. It then crossed the Alaska Range at Isabel Pass and the Chugach mountains at Thompson Pass before dropping into the port of Valdez through the Keystone Canyon (Borneman 2003).

EuroAmerican Expansion

In 1812, the Russian hold on Alaska was becoming weak, as American hunters and trappers were encroaching on Russian territory. The settlement that gave Americans the right to trade fur only below the 55°N latitude was generally ignored, making the Russian position in Alaska even weaker. Eventually, the Russian American Company entered an agreement with the Hudson's Bay Company to allow British sailors passage through Russian territory. Russia decided to sell its lands to North America, and in 1867, William H. Seward, the US Secretary of State, secured the purchase of Alaska from the Russians. Alaska became a state in 1959 (Borneman 2003).

Railroads. The Copper River and Northwestern Railroad, which was originally constructed to bring ore from the Wrangell Mountains to the Guggenheim smelter in Tacoma, Washington, constructed in 1911 (Borneman 2003). The railroad went through Kennecott, Bennett, and other cities that underwent a major growth spurt and a "boom" as they served the copper mines, miners, and served as railroad stops. The Great Depression and the fall in prices of copper, the railroad shut down and was no longer in use. The line was in use for only twenty-seven years (Borneman 2003).

The Alaska Railroad was established in April 1915**.** The line was to extend from Seward to Fairbanks, a seventy-two mile stretch. Completed in 1922, the rail line brought freight and passenger traffic to Alaska and serviced some of the most populated cities in Alaska, such as Seward, Anchorage, and Fairbanks. The line was instrumental in transporting military and civilian supplies and materials during World War II. The line has been upgraded several times and continues to be a transportation link (Alaska Railroad 2008).

Alaska Marine Highway. The period after World War II was a period of expansion for Alaska. One example is the Alaska Marine Highway. By 1963, three ships in the southeast region went into service, creating the Alaska Marine Highway, which ran regularly scheduled trips to the major towns along the Inside Passage (Borneman 2003).

Trails

Iditarod Trail. The Iditarod trail was a path originally used by Native American hunters and Russian explorers. In the twentieth century, gold seekers used the trail to reach the mines, and the trail was improved. Several towns such as Seward, Iditarod, and Nome grew up around the mining districts, where miners would buy supplies from local stores and markets and stay overnight in tents prior to going off to the mines. The trail begins in two places, at Seward and at Nome, and eventually met at the Iditarod Mining District. It was officially surveyed by the U.S. Army's Alaska Road Commission in 1908. It was heavily used until 1924, but its use diminished as the use of airplanes became more common. In the 1960s, interest in dog sledding and use of the trail was revived and the first Iditarod race took place in 1967 (Bureau of Land Management 2007). The trail is now part of the National Trails Service of the National Parks System.

NORTHWEST COAST

The Northwest Coast culture region covers areas between the crest of the Cascades and the ocean from the Copper River delta and Yakutat Bay in Alaska south to the Winchuck River and Cape Mendocino in California (Figure 3-19).

The region does include parts of Canada, but since this part of the Pacific coast is not included in the project area, it is not discussed here. The region is highly varied and is divided into three subareas for purposes of discussion: North, South, and Central (Neusius and Gross 2007; Suttles 1990a). The project area encompasses part of the Northern subarea and all of the South and Central subareas.

USFS regions included in the Northwest Coast region include portions of Regions 5, 6, and 10. BLM District Offices included in the region include all or portions of the Medford, Coos Bay, Roseburg, Eugene, Salem, Spokane, and Anchorage offices.

Table I-2 identifies the Northwest Coast culture region languages and tribes that have been documented within the project area. Culturally, the Northwest Coast culture region is bordered by the Arctic to the north, the Plateau to the east, California to the south, and the Subarctic to the north and east.

Table I-2
Languages and Tribes of the Northwest Culture Region in the Project Area

Languages (Linguistic Phylum; Culture Region)	Tribes
Athapaskan (Na-Dene)	Kwalhioqua, Clatskanie, Umpqua
Tlingit (Na-Dene)	Tlingit
Chinookian (Penutian)	Chinookans
Kalapuyan (Penutian)	Kalapuya
Kusan (Penutian)	Coosans
Takelman (Penutian)	Takelma
Yakonan (Penutian)	Alsea, Siuslaw
Wakashan (Undetermined linguistic phylum)	Makah
Salishan (Undetermined linguistic phylum)	Southwestern Coast Salish, Central Coast Salish, Southern Coast Salish, Tillamook
Chimakuan (Undetermined linguisticphylum)	Quilete, Chemakum

Source: Suttles 1990b; Neusius & Gross 2007; Waldman 2000

A general chronology of the Northwest Coast has been developed based on developments in lithic technology and social organization (Neusius and Gross 2007). Similar to California and other coastal regions, the early prehistory of the Northwest Coast has been dramatically affected by post-glacial sea level rise, resulting in inundation of the coastline and altering coastal environments. The entirety of the Northwest Coast was ice-free as of 12,000 years ago (Neusius and Gross 2007; Suttles 1990a), although lands immediately adjacent to the Pacific Ocean were never glaciated. The region though is unique in that its moist nature has led to excellent preservation in many saturated sites. Although a few sites and surface finds have been attributed to Paleoindian occupations, these are not definitive points of evidence for an early occupation of the Northwest Coast. The following outlines the general chronology of Northwest Coast (Neusius and Gross 2007).

- Paleoindian: pre-10,000 BP
- Archaic: 10,000 – 6400 BP
- Pacific: 6400 – 175 BP
- Early Pacific: 6400 – 3800 BP
- Middle Pacific: 3800 – 1800/1500 BP
- Late Pacific: 1800/1500 – 175 BP
- The Historic period then follows the Late Pacific Period.

CULTURAL HISTORY

Prehistoric

Paleoindian: Due to the above mentioned effects of deglaciation, much of the critical coastal areas where one would expect the earliest sites representing migration through the Northwest Coast into North America are under water (Neusius and Gross 2007). However, in general, sites older than 5000 BP are not considered abundant (Carlson 1990). Some Clovis points have been found in the region, but these are typically isolated surface finds, which makes their association with other artifacts questionable. The nearest accepted evidence of Paleoindian activity is a cache of points in the Plateau region on the opposite side of the Cascade Range (Neusius and Gross 2007). As in California, the scarcity of such artifacts in the Northwest Coast may be due to the rise of sea level and subsequent submersion of the coastline.

Archaic: Archaeological evidence suggests that Northwest Coast peoples of the Archaic Period existed in small, mobile populations with large territories. This results in primarily ephemeral sites for this period. Both terrestrial and marine resources, including salmon a basis of later diets, were exploited (Neusius and Gross 2007).

Four major technological complexes characterize the Archaic Period in the Northwest Coast culture region. These complexes occur concurrently in different areas as well as successively in the same area. These are: the Fluted and Stemmed Point Traditions, which spread between 10,950 – 9950 BP toward the coast along the Columbia River from interior North America, and the Pebble Tool and Microblade Traditions which spread southward along the coast and inland up river valleys, first appearing in the Northwest Coast between 9950 and 8950 BP (Neusius and Gross 2007; Carlson 1990).

The Fluted Point Tradition is poorly represented in this culture region, and as it is in other culture regions, is mostly documented via isolated and surface finds of fluted points. Unlike other regions, they are rarely associated with faunal remains or other artifacts. Given the relative lack of evidence for this tradition, it would appear that it did not last for very long in the Northwest Coast culture region. It is most likely derived from the Great Basin and transferred or migrated down the Columbia River and its tributaries (Carlson 1990).

The earliest sites in the Tlingit and Haida regions of northern Northwest Coast have Microblade Tradition components (Carlson 1990). Ground Hog Bay 2 and Hidden Falls are two sites within the project area in the Northwest Coast that are attributed to this tradition, the former, on the Chilkat Peninsula, being the oldest concurred upon site of the Microblade Tradition. It is thought that these two sites represent the spread of microblade technology from interior Alaska south (Neusius and Gross 2007). The technology continued to move southward through the Archaic and subsequent Pacific Period (Carlson 1990). Some sites in the region however may represent spread in the opposite direction, from the south to the north. The Microblade Tradition is characterized by microblades, microblade cores, pebble tools, and flakes, with bifaces being rarities (Neusius and Gross 2007). Sites with components representing this tradition are typically located where access and survival demanded developed water transport technologies and use of marine resources. Additionally, the inclusion of other point types and technologies in tool kits of some sites suggest influence from the Plateau to the east (Carlson1990).

In the project area the Pebble Tool Tradition is present in archaeological sites from the Puget Sound south to the lower reaches of coastal rivers, however in totality the tradition reaches further north into Canada near the Queen Charlotte Islands. This tradition also has various local expressions that are referred to by other names (Carlson 1990). Bifaces, particularly stemmed leaf-shaped points, accompanied by pebble tools characterize this tradition (Carlson 1990; Neusius and Gross 2007). Additionally a bone and antler industry is present while microblades are absent. Some sites indicate an interface between the Pebble Tool and the Stemmed Point Traditions (Carlson 1990). Overall however, the Pebble Tool Tradition is more similar to assemblages found in the Plateau, Great Basin, California, and Southwest regions. One of the most important archaeological sites of this tradition is within the project area in The Dalles, Oregon along the Columbia River. This is a fishing site that spans the Archaic and all subsequent periods, into modern times, indicating the significant time depth of fishing in this area (Neusius and Gross 2007). The Pebble Tool Tradition began as a marine-adapted culture that spread upriver and into the mountains and interior of the Northwest Coast, most likely following salmon runs. Sites are typically situated along rivers where fishing, particularly of salmon, and terrestrial mammal hunting would have provided the major forms of subsistence resources, supplemented by marine resources. In general, occupations of the Pebble Tool Tradition suggest a fishing and sea mammal hunting culture with sufficient technology to construct and use watercraft early on (Carlson 1990).

The Stemmed Point Tradition is primarily situated along the Columbia River and emanating from interior North America. In fact, there are several early Archaic Period sites along the eastern Northwest Coast boundary with the Plateau culture region. Representation of the technological tradition along the coast is rare. It is characterized by chipped stone crescents and long stemmed points. A focus on hunting typifies the associated cultural activities (Carlson 1990).

Several of the above patterns persisted into historic times. The disparate technologies suggest different cultural traditions with their own technologies existed within the cultural region of the Northwest Coast. However, between the time of their initial appearance in the region and 4950 BP (Early Pacific Period) the differences among the cultures using these early traditions were being homogenized as people adapted to the environment, populations grew, and relationships between groups expanded (Carlson 1990).

Pacific: During the Pacific Period the Northwest Coast region developed a variety of characteristics that distinguish it from neighboring culture areas and several of the Archaic technological traditions continue (Carlson 1990; Neusius and Gross 2007). This includes increases in populations leading to increased sedentism with cyclical rounds of permanent village sites with pithouses and later the characteristic wooden plank house. Economies were focused on aquatic resources particularly salmon in some areas. Storage of resources became important and the notable woodworking and art styles of the region developed during this period. All these developments point to an increasing social complexity of Northwest Coast tribes during the Pacific Period.

The Early Pacific Period is characterized by a lack of microblade cores seen during the Archaic, and use of bone and antler tools. Groundstone tools were replaced by chipped stone tools in many areas. Midden sites are larger in size and are denser in their assemblages compared to the earlier ephemeral Archaic sites. Economies were diverse, but a focus on seafood is apparent when looking at faunal assemblages and isotopic analyses of human bone from burials, which are commonly found for this period. Other evidence points to a developing emphasis on riverine resources as well. Burials and grave goods also provide evidence of achieved status of elites in populations. Other burial data suggest violence and conflict between groups, which is supported by the location of some sites in the northern subarea on bluff tops and other such defensible locations (Neusius and Gross 2007).

During the Middle Pacific Period, certain activities were intensified, especially fishing with the extensive use of nets and large fish weirs. Wooden storage boxes are first seen during this period signaling the importance of food storage as populations continued to expand substantially. The characteristic wooden plank house makes its first appearance too during this time. Planks could be removed and re-established in other areas allowing some form of residential mobility. Incidence of violence continued to increase in the northern subarea of the region, while it appears to have been much less common in the southern areas. Social hierarchies developed throughout the region on individual and village levels and was now based on ascribed status, rather than achieved. There are even possible indications of slavery during this time. Art is rare during this time, but those examples that have been found foreshadow the characteristic styles recorded for the region (Neusius and Gross 2007).

If the Middle Pacific Period saw the early beginnings of historically recorded lifestyles of the Northwest Coast, the Late Pacific Period saw their full development and a peak in population numbers, represented by a high number of sites. Flaked stone tools are entirely replaced by bone, antler, and groundstone tools. Subsistence economies continued to become intensified, but not all were focused on salmon fishing. Groups appear to have focused on what was locally important to them. Throughout however, storage continued to be a mainstay of economies with continued use of wooden boxes and also baskets. There was greater use of nearshore and offshore resources as indicated by an array of fishing implements and tools for sea mammal hunting, including nets, weirs, traps, tackle with hooks, weights, lines, and toggling harpoons. Tools for woodworking are also prominent in archaeological assemblages, presumably a result of the focus on house construction, although they would have also been used for construction of bentwood storage boxes and canoes. Remains of plank houses are more common during this period as well, including whole ones at the Meier site near Portland, Oregon within the project area. Evidence for individual social stratification is not as apparent as previous periods based on the lack of in-site burials along the coast. Instead evidence for village hierarchies is based on the presence or lack of village-associated burial mounds, such as those in the Fraser River and Willamette Valley areas. It should be noted however, that there is evidence for social ranking within houses. Burials and village locations in defensive areas, such as bluff tops and built fortifications, provide evidence of increased violence throughout the Northwest Coast region. The distinctive Northwest Coast art style was fully developed in the Late Pacific Period, although there are fewer art objects found (Neusius and Gross 2007).

Historic

Early explorers were the first non-Native contacts in the Northwest Coast culture region. In particular, the fur trade brought much interaction between Europeans and native Northwest Coast populations. Trading posts were established in the region to facilitate such trade between the Native Americans, Russians, and other Europeans. A variety of artifacts are found in archaeological sites that were received as part of the fur trade. However, relations between the tribes and the new settlers were often hostile (Neusius and Gross 2007).

Euro American Contact

Spain and England sent explorers to the northwest coast region, during the 1770s. Russia also led expeditions to the region in 1741. Captain James Cook, a British sailor, landed in Northwest Coast region, and attracted fur traders and trappers with news of fur resources in area (Schwantes 1989; Hayes 1999). Fur traders and trappers from the America and Canada also found new overland routes to the Northwest Coast region from the east and north through various trails.

Trade

Fur. The discovery of sea otters during the explorations of the Northwest Coast region spurred a period of fur trading for export to Asian and European markets that lasted until 1850 (Neusius and Gross 2007). Permanent trading posts were established in 1799, first by the Russians at Tlingit, and then by the Americans, who established a post on the lower Columbia in 1811. Many fur trappers and traders from the United States and Canada found new routes to the region.

Mining. The discovery of gold in the Coast Range of Oregon and Washington in the 1850s brought settlers and gold miners to the area. In addition to gold, mined resources in the northwest included silver, copper, sand, salt, gravel, phosphate, and coal (Schwantes 1989). There was a significant coal mining industry east of the Seattle and Tacoma area and west of Ellensburg during the 1870s and 1880s. This coal mining industry in Pierce and King Counties, in the foothills of Mount Rainiere, had a typical boom and bust cycle that most other mining settlements of the time shared (Washington 2008).

Fishing, Timber, and Agriculture. The economic foundation of the Northwest Coast region came from the fishing, timber and agricultural industries. Commercial fishing became popular during the late-nineteenth century, with salmon being the most desired fish product. Canneries and salteries were established along the Columbia River.

The vast forests of the region were attractive to the timber industry. California mines, cities, and ships required huge amounts of lumber, and the deep waters and forested shorelines of Pacific Northwest offered the most convenient place to get these commodities. The availability of cheap river and ocean transportation allowed entrepreneurs access to world and domestic markets through Portland, Seattle and other ports. Docks and sawmills appeared to deliver wood products to the ships that sailed away to San Francisco and other Pacific ports Farm products from the Willamette Valley, minerals from Idaho, and wheat from around Walla Walla all traveled to market via riverboats to the port cities.

Western Expansion

<u>*Trails*</u>

Oregon Trail. The Oregon Trail was a major route for trappers, traders and settlers traveling to the Pacific Northwest from the east. The Trail began as an unconnected series of trails used by the Native Americans. Fur traders expanded the route to bring pelts to trading posts in the early 1800s. The route extends roughly 2,000 miles west from Missouri toward the Rocky Mountains to the Willamette Valley. A trail to California digressed from the route in Idaho (Bureau of Land Management 2007). Several groups followed the route over time including large populations of settlers, moving from the eastern portion of the US to settle the west between 1800 and 1880s. (Bureau of Land Management 2007).

Missionaries used the trail during the 1830s, traveling along the Platte and Snake Rivers to settle churches in the Northwest. Mormons, headed toward Salt Lake in Utah, used the trail beginning in 1847, and the discovery of gold in California caused many gold miners to use the trail in 1849. It is estimated that four thousand emigrants followed the trail west in 1847 (Schwantes 1989), many in small caravans of wagons. Military posts and spur roads were established off the Oregon Trail. It was used as a cattle driving trail eastward for a brief time as well. The construction of the Central Pacific Railroad, connecting California to the rest of the continent in 1869, decreased use of the Oregon Trail and by the early 20th century, the trail was no longer used as a major transportation corridor, as railroad lines paralleled the trail (Bureau of Land Management 2007, Schwantes 1989).

Applegate Trail. This trail was used originally to link the Northwest Coastal area to Oregon. It crosses the Black Rock Desert, the High Rock Canyon, and into the Warner Mountains to Central California. The trail ends in Oregon (Bureau of Land Management 2007). This southern route of the Oregon Trail, established in 1846 by the Applegate brothers was considered a safer route to Oregon as it bypassed and avoided the obstacles of the Burnt River Canyon, the Blue Mountains, and the Columbia River (Webtrail 2007).

Cowlitz Trail. This trail is not on BLM or Forest Service land and has not been designated as a National Historic trail. It was used in 1839, to connect the Willamette Valley with the Puget Sound Basin. The trail was a muddy footpath in 1845, used to connect Fort Vancouver to South Puget Sound. Hudson's Bay Company traders used it as had Native Americans before them. The trail has disappeared throughout the years with the construction of roads over it (City of Tumwater, Washington 2005)

Lewis and Clark. This trail runs along the explorations of Meriwether Lewis and William Clark. The trail follows the Missouri River upstream, eventually reaching the Pacific Ocean at the mouth of the Columbia River. The route goes through Idaho and western Montana (USDA Forest Service 2003).

Railroads
The Northern Pacific Railroad was constructed in 1873, and by 1883, it was connected to Minnesota and the remainder of the eastern portion of the U.S. This rail line increased settlement and immigration to the area, as well as enabled railroad communities to be established. The railroad enabled the lumber and agriculture industries as raw materials could be transported from the Northwest Coast to more easterly regions of the United States.

Rivers and Ports
Large rivers and port towns of the northwest provided a crucial link between these remote territories and the outside world. The access provided by the Columbia River and its tributaries enabled shipment of goods to and from inland settlements. In the 1850s, timber mill towns began to develop in the Puget Sound area because of the deepwater anchorage that protected ships from Pacific storms (Schwantes 1989). These waterways enabled the industries of the northwest to supply the California coastal cities until the railroad boom of the 1880s.

Plateau

The Plateau culture region comprises the area drained by the Columbia and Fraser Rivers, with the exception of some areas within the Great Basin (Figure 3-20). In general, the area covers parts of British Columbia, eastern Washington, western and northern Oregon, the Idaho panhandle, and western Montana.

USFS regions included in the Plateau region include portions of Regions 1, 4, 5, and 6. BLM Offices included in the region include all or portions of the Spokane, Vale and Prinevale District Offices and Coeur d'Alene, Cottonwood, Missoula, Dillon and Butte Field Offices.

Table I-3 identifies the Plateau culture region languages and tribes that have been documented within the project area. Generally, Salish speakers are associated with the Northern Plateau, Sahaptin speakers with the south, Chinookan speakers with the west, Klamath-Modoc speakers with the southwest, and the Cayuse and Molala speakers with isolated areas of the region (Neusius and Gross 2007). Culturally, the Plateau culture region is bordered by the Northwest Coast on the west, the Plains on the east, the Great Basin on the south, and the Subarctic on the north. The Southern and Eastern Plateau subareas are within the U.S., while the Northern area is primarily in Canada.

The Plateau region has typically experienced cool climates since glaciers cleared from the area around 11,000 BP. However, the area has witnessed a period of warming since 2800 BP (Neusius and Gross 2007). Human occupation of the Plateau culture region began around the time of glacial retreat. A cultural chronology consisting of Early, Middle, and Late Periods, the Middle and Late

Table I-3
Languages and Tribes of the Plateau Culture Region in the Project Area

Language (Linguistic Phylum)	Tribes
Salish (Undetermined linguistic phylum)	Coeur d'Alene, Flathead and Pend d'Oreille, Kalispel, Middle Columbia River Salishans, Northern Okanagan, Lakes, and Colville, Spokane, Thompson
Sahaptian (Penutian)	Umatilla, Walla Walla, Nez Perce, Palouse, Western Columbia River Sahaptins, Yakima and Neighboring Groups
Chinookan (Penutian)	Wasco, Wishram, Cascades
Klamath-Modoc isolate (Penutian)	Klamath, Modoc
Molalla isolate (Penutian)	Molala
Cayuse isolate (Penutian)	Cayuse
Kutenai isolate (Macro-Algonquian)	Kootenai

Source: Neusius and Gross 2007; Waldman 2000; Walker, Jr. 1998a

Periods being divided into subperiods, has been developed based on archaeological and ethnographic research (Chatters and Pokotylo 1998; Neusius and Gross 2007).

- Early Period: 11,500 – 8000 BP
- Middle Period: 8000 – 4000 BP
- Early Middle Period: 8000 – 5300 BP
- Late Middle Period: 5300 – 4000 BP
- Late Period: 4000– 230 BP
- Early Late Period: 4000 – 2500 BP
- Middle Late Period: 2500 – 1500/1000 BP
- Late Late Period: 1500/1000 – 230 BP

Area-specific culture chronologies for the Southern Plateau include Period I (11,500 – 6950/5950 BP), Period II (6950/5950 – 3850 BP), and Period III (3850 – 230 BP) (Ames, et al 1998). Within the Eastern Plateau, prehistory has been divided into a three-phased chronology including Early Prehistoric Period (pre-9950 – 6950 BP), Middle Prehistoric Period (6950 – 1450 BP), and Late Prehistoric Period (1450 – 230 BP) (Roll and Hackenberger 1998). It should be noted that areas within these subregions exemplify their own characteristics during these periods and researchers have developed additional subperiods and phases.

Archaeological research has uncovered specific common cultural patterns in this region including (Neusius and Gross 2007; Waldman 2000; and Walker, Jr. 1998b):

- Linear settlement patterns along rivers;
- Diverse subsistence base of fish, game, and roots;
- Complex fishing technology;
- Intermarriage and cooperative use of subsistence resources among groups;
- Institutionalized trading throughout the area;
- Village and band levels of social organization; and
- Relatively uniform mythology, art styles, and religious practices.

CULTURAL HISTORY

Prehistoric

Early Period: There is little archaeological evidence for very early human occupation of the Plateau culture region compared to subsequent time periods. In fact, only one extensive Paleoindian Clovis (11,500 – 10,800 BP) archaeological site has been found. All other archaeological evidence of human occupation during this period is found in surface scatters of artifacts and single, isolated artifacts (Chatters and Pokotylo 1998; Neusius and Gross 2007).

Post-Clovis Early Period inhabitants of the Plateau region appear to have lived in small, mobile hunter-gatherer groups (Chatters and Pokotylo 1998; Neusius and Gross 2007). Groups were organized into semi-permanent villages with temporary subsistence camps at higher elevations. Winter villages were typically located along main rivers, while summer villages were established at the higher elevations (Chatters and Pokotylo 1998; Waldman 2000; Walker, Jr. 1998b). A wide variety of subsistence resources were used including riverine resources and large game. Within most sites located along rivers, fishing is demonstrated by artifact assemblages to be the most important subsistence activities. The majority of sites from the Early Period are open sites where large game and hunting implements dominate the artifact assemblage. However, fish bones are still quite common in these assemblages (Neusius and Gross 2007).

Projectile points are also very common artifacts within the region. Specific styles can provide excellent temporal markers for Plateau archaeological sites and they vary spatially (Neusius and Gross 2007). Other artifacts that are common to Plateau region Early Period archaeological sites include a variety of stone tools (cobbles, bifaces, scrapers, gravers, burins, and bola stones), bone tools (points, awls, and needles), beads, and antler wedges. Sometimes millingstones, anvil stones, abraders, and antler flakers are also found (Neusius and Gross 2007).

There is spatial variation of settlement and artifacts patterns within the Early Period. Typically, sites in the northern portion of the Plateau region have limited assemblages that include microblades and flake tools. Meanwhile southern Plateau region sites appear to be short-term occupations with small, low-density artifact assemblages lacking microblades. Towards the end of the Early Period, a pattern of increased numbers of expedient tools emerges (Chatters and Pokotylo 1998; Neusius and Gross 2007).

Middle Period: Settlement patterns during the Middle Period are mostly within low-elevations. However, near the end of the period there is evidence in the eastern Plateau of limited collecting activities in higher elevations (Neusius and Gross 2007).

The Early Middle Subperiod is largely a continuation of Early Period cultural patterns with some distinct variations (Chatters and Pokotylo 1998; Neusius and Gross 2007). In the northern Plateau people practiced a foraging strategy hunting for deer, elk, and other game, as well as fish and birds. Given this dominant subsistence pattern, it is no surprise that pithouses are absent from northern Plateau sites of this age. There is also evidence in the northern Plateau of local populations being replaced by Salishan speakers from the coast, possibly a result of these coastal populations following salmon upstream (Neusius and Gross 2007). Meanwhile, in the southern Plateau region tool technology became more simplistic and expedient (Chatters and Pokotylo 1998; Neusius and Gross 2007). Subsistence remains from sites indicate use of an optimal foraging strategy, where more productive foods are obtained over less productive ones (Neusius and Gross 2007). Throughout the region a new burial pattern, the Western Idaho burial complex, appears between 6000 and 4000 BP. The pattern incorporates multiple interments in a single burial, and sometimes includes cremations. The burials are located away from habitation sites and include a wide variety of grave goods that appear to indicate long-distance trade (Neusius and Gross 2007).

The mobile hunter-gatherers of the Early Middle Subperiod became more sedentary during the subsequent Late Middle Subperiod (Chatters and Pokotylo 1998; Neusius and Gross 2007). Artifact assemblages and other patterns of the Early Middle Subperiod are generally the same during this later subperiod. The occurrence of pithouses at Middle Period sites and their location in areas where a majority of resources can be collected are considered indicative of sedentism. Most often the pithouses will be found close to the steppe-forest margins of the lowlands (Chatters and Pokotylo 1998; Neusius and Gross 2007). A drop in sites with pithouses occurs however near the end of the Late Middle Subperiod, possibly indicating a drop in the population, particularly in the southern Plateau region. Throughout the period though there is an increase faunal diversity, riverine resources, and trade goods compared to the Early Middle Subperiod. In fact, salmon storage begins to appear in the northern Plateau, indicating a very high reliance on riverine resources (Neusius and Gross 2007).

Late Period: The ethnographically recorded traits of Plateau tribes formed during the Late Period. The period also witnessed the introduction of the horse to the region.

Once again, sedentism in the Plateau region increases during the Early Late Subperiod, signified by the presence of food storage at permanent camps with pithouses and intensive use of resources such as salmon (Chatters and Pokotylo 1998; Neusius and Gross 2007). In the southern Plateau region, this was the first reappearance of pithouses after several centuries (Chatters and Pokotylo 1998). Studies of human skeletons from this time period have shown that more than half the protein in individual's diets came from marine resources (Neusius and Gross 2007). This change in subsistence patterns may partially be due to a changed environment during this subperiod. With cooler, moister climate at this time, salmon availability increased as well as forest cover, which led to less large game populations. It should be noted that the people of the Eastern Plateau remained somewhat mobile (Neusius and Gross 2007). Reliance on trade may have decreased during this time, as indicated by an increase in stone tools of locally available materials and the development of local regional styles of projectile points (Chatters and Pokotylo 1998; Neusius and Gross 2007).

Sedentism continued to increase during the following Middle Late Subperiod. Also occurring during this time was the development of a hierarchical social organization. Traded exotic items are found in concentrations in some elaborate burials of this time, indicating the developing social hierarchy, along with other luxury items, distinct variations in house size, and incidents of violence. Large pithouse villages are most common in the lower reaches of large rivers (Neusius and Gross 2007). Although salmon fishing remained a staple of people's diets, the importance of root crops increased during the Middle Late Subperiod and people expanded their collection activities into the uplands (Chatters and Pokotylo 1998; Neusius and Gross 2007). A boom in bison populations in the Columbia Basin may have attracted Plateau peoples to this arid part of the region where large bison kill sites are found (Neusius and Gross 2007). The bow and arrow was adopted during this subperiod between 2400 and 2100 BP in the south and around 1500 BP in the north (Chatters and Pokotylo 1998;Neusius and Gross 2007).

Many of the Middle Late Subperiod archaeological characteristics continue into the Late Late Subperiod of the Plateau region. However, evidence points to a decline in population, with the exception of the Upper Columbia River, and perhaps an evening out of the social hierarchy (Chatters and Pokotylo 1998, Neusius and Gross 2007). Use of the uplands appears to have diminished during this time as well (Chatters and Pokotylo 1998). There is also evidence of population migrations within the region during this late time, establishing the historically recorded tribal territories. Such movements are most often indicated by changes in house form and artifacts (Chatters and Pokotylo 1998; Neusius and Gross 2007).

Historic

Euroamerican influences began to have a major effect on the native cultures in the Plateau region between 1600 and 1750 AD. Explorers and traders brought disease, new trade goods, market economies, introduction of the horse, and missionization. Epidemics appear to have infiltrated the Plateau from the Northwest Coast as explorers moved inland. Trade and kin relations between the regions and within the Plateau only encouraged the spread of the diseases. Burial patterns were altered in response to these widespread deaths, including cremation, canoe burials, and burials in cedar cists, fenced enclosures, and log enclosures (Neusius and Gross 2007; Walker, Jr. 1998b).

Native trade became more long range during the historic period, mostly due to the introduction of the horse. Plateau peoples even traded with non-Native Americans in New Mexico, along the Upper Missouri River, and in the California Central Valley. Trading within the Plateau culture region typically took place at major trading locales, like The Dalles and Kettle Falls, where trade was important prehistorically (Neusius and Gross 2007). The horse also led to increased warfare among tribes and culture regions as mounted warriors had a distinct advantage over those on foot. Warfare was most common along the boundary between the Plateau and the Plains culture regions where war chiefs and warrior societies developed (Neusius and Gross 2007).

Euro American Contact

European contact with Native Americans in the Plateau region may have occurred as early as the sixteenth century with Russian and Spanish explorers. An early documented contact between the Euro-American and Native Americans was the expedition of Lewis and Clark in 1805 (Walker and Sprague 1998). Missionaries were also among the early non-Native settlers to the region. The first permanent missionaries established in the Oregon area were Presbyterian, who converted the Nez Perce tribe from 1836 to 1847. Jesuit missionaries arrived in 1838, and Mormon missionaries in Idaho by spring 1860. Catholic missionaries also set up churches in the region, beginning in 1838, and by 1855, there were Mormon missions in the Plateau region (University of Washington 2007).

Trade

The Fur Trade. Fur trading attracted Euro-American settlers to the region from the 1790s until 1846. (Schwantes 1989). The fur trade began as maritime fur trading and then land-based fur trade reached the region by the mid-1890s (University of Washington 2007). The fur trade played an important role in the history of the region as it facilitated contact between Russian, French and British traders and Native Americans. Native Americans participated in this industry by selling or bartering pelts to the European traders who then resold them in other markets, such as China (University of Washington 2007).

One of the oldest and most best known fur trading companies in the area was the British Hudson's Bay Company, established as early as 1670 which controlled the fur trade throughout much of North America. The most popularly traded fur was the beaver and sea otter. Fur trading companies such as the Hudson's Bay Company established forts and posts and devised interior routes of travel which had lasting impacts for settlers to the region. Fur traders also used local natural resources such as timber, fish, and farmland which showed future settlers how the area could be used for sustenance. The Hudson's Bay Company guided the policies of the area, and most native American plateau peoples were under the administration of the company until that time, although the region did not have many Euro-American settlers until 1846 (Walker 1998). Thousands of settlers came to the region by 1846.

Competing fur trading companies established themselves in the area in the 1780s (Schwantes 1989). For example, the North West Company had a fort where the Columbia and Walla Walla Rivers met in 1818, sending fur trappers into the Snake River region until 1821 (Schwantes 1989). The company successfully opened the interior of Oregon but was eventually absorbed by the Hudson's Bay Company (Schwantes 1989).

Mining. Mining has been a part of the Plateau region history since the 1850s when gold was discovered in several locations in Southern Oregon (Schwantes 1989). Discoveries of gold in Idaho and Montana in the 1860s gave way to a large flow of settlers to the region. Gold was discovered in the Plateau region on Gold Creek, a tributary of the Clark Fork River in Montana in1860 (US Forest Service 2007). The discovery of gold triggered an influx of miners into the Plateau region in large numbers, mining for not only gold but silver, led, iron, copper, salt, sulpher, mica, marble and sandstone in areas such as present-day Idaho, Washington, and Montana (Idaho State Historical Society 2007).

Agriculture and Fishing. Farming, fishing, logging, and ranching were other economic mainstays in the Plateau region. Hudson's Bay Company was among the first to develop the region's agriculture, timber and marine resources (Schwantes 1989). Logging became an economic mainstay Thousands of acres were dedicated to orchards producing prunes, walnuts, filberts, and other fruit and nut crops.

Salmon was the primary product for fisheries in the region, although oysters, clams, shrimp and halibut were also caught and sold commercially (Schwantes 1989). During the 1820s through the 1860s, numerous fisheries and canneries were established along the Columbia River. Eventually, the salmon population was depleted because of over-fishing. In the twentieth century, the salmon population was further inhibited by the construction of the Grand Coulee Dam in 1941, which was constructed without fish ladders, and the Bonneville Dam, constructed in the 1930s, which altered the fisheries and opened new areas to agriculture and ranching through irrigation and flood control (Schwantes 1989). Although conservation measures were put into place in later years, the salmon population was not fully restored because of overfishing, agricultural diversion and hydroelectric (damming) activities (Schwantes 1989).

Agricultural production of wheat and ranching of cattle were other economic activities in the region. Crops such as wheat, nuts, fruit, and hops were among those grown in the area, beginning in the mid-1800s. Western Oregon saw the planting of a wider range of crops such as hops for beer brewing, flax for making linen, and hemp for rope and paper. Irrigation and transportation improvements allowed expansion of agriculture and the development of large-scale fruit orchards between 1905 and 1915 (Oregon Secretary of State 2007). Logging was also an economic mainstay, and with the advent of the railroad, lumber could be hauled to steam-operated mills along the railways. The region was shipping large portions of its timber by railroad to a quickly growing U.S. population by the late 1800s (Oregon Secretary of State 2007). The flat farmlands of the region were also used for cattle and sheep raising, and cattle were run from California, through the Willamette Valley and over the Oregon Trail (Schwantes 1989). Cattle were raised in eastern Oregon to provide meat to feed gold miners in the 1860s (Oregon Secretary of State 2007).

Western Expansion

Originally Spain, Great Britain, Russia, and the United States each claimed the land encompassing the Plateau and northwest coast regions. Claims were settled by treaties and diplomacy over the course of 30 years in the first half of the 19th century. A continuous flow of American settlers to the region led to the establishment of the Oregon Territory in 1848. This was followed by the Washington Territory in 1853, Idaho Territory in 1863 and Montana Territory in 1864(Schwantes 1989). These territories secured American position in the region. Military presence increased in the Plateau region with the establishment of several forts including: Fort Dalles (1850), Fort Cascades (1853), Fort Walla Walla (1856) and Fort Klamath (1863) (Beckham 1998). The Plateau region was further settled after 1859 when treaties opened the area east of the Cascade Mountains for settlement.

Oregon Trail. The Oregon Trail was used by settlers traveling to the Plateau Region or to pass through the area on their way to more westerly points. The Trail began as an unconnected series of trails used by the Native Americans. Fur traders expanded the route to bring pelts to trading posts in the early 1800s. The route extends roughly 2,000 miles west from Missouri toward the Rocky Mountains to the Willamette Valley. A trail to California digressed from the route in Idaho (Bureau of Land Management 2007). Several groups followed the route over time including large populations of settlers, moving from the eastern portion of the US to settle the west between 1800 and 1880s (Bureau of Land Management 2007).

Missionaries used the trail during the 1830s, traveling along the Platte and Snake Rivers to settle churches in the Northwest. Mormons, headed toward Salt Lake in Utah, used the trail beginning in 1847, and the discovery of gold in California caused many gold miners to use the trail in 1849. It is estimated that four thousand emigrants followed the trail west in 1847 (Schwantes 1989), many in small caravans of wagons. Military posts and spur roads were established off the Oregon Trail. The trail was the major connection between the east and western portions of the US. It was used as a cattle driving trail eastward for a brief time as well. The construction of the Central Pacific Railroad, connecting California to the rest of the continent in 1869, decreased use of the Oregon Trail and by the early 20th century, the trail was no longer used as a major transportation corridor, as railroad lines paralleled the trail (Bureau of Land Management 2007; Schwantes 1989).

Railroads. The completion of the Northern Railroad in 1883 furthered population growth and economic development of the Plateau region. The farming and agriculture industries benefited from the construction of the railroad because it allowed for transportation of crops to eastern states, and farming equipment manufactured in the eastern states were shipped to the Plateau territories. The construction of the railroad supported the logging industry as well because steam engines were used to export lumber to mills and logging could be done in rugged areas that were inaccessible prior to the railroad (Oregon Secretary of State 2007).

GREAT BASIN

The cultural region of the Great Basin is based on the hydrographic region of the same name, but is extended to include the area between the Sierra Nevada and the Rocky Mountains (Figure 3-17). In general, the area covers most of Nevada and Utah, parts of Oregon and Idaho, eastern California, western Colorado, and western Wyoming. Like other culture regions, the Great Basin is varied in landform and climate with high peaks overlooking deep valleys with broad and arid floors. These different environments within the region require a variety of adaptations that have resulted in diverse cultural traditions (Neusius and Gross 2007).

USFS regions included in the Great Basin region include portions of Regions 1 though 6. BLM Offices in the region include all or portions of the Elko, Ely, Battle Mountain, Carson City, Winnemucca, Las Vegas, Vale, Burns, Lakeview and Prinville District Offices as well as Salt Lake, Filmore, Ceder City, Eagle Lake, Surpise, Bishop, Jarbidge, Owhee, Bruneau, Burley, Pocatello, Shoshone, Challis and Upper Snake Field Offices.

All ethnographically recorded Great Basin culture region tribes spoke languages of the Uto-Aztecan family (Aztec-Tanoan Phylum) (D'Azevedo 1986a; Waldman 2000). The one exception are the Washo of northern Nevada and northeastern California whose language is often classified as Hokan (Neusius and Gross 2007), but bears no strong relation with any other language. Numic is the branch of the Uto-Aztecan language family that includes many of the languages spoken by Native American peoples traditionally living in the Great Basin, Colorado River basin, and southern Great Plains. Culturally, the Great Basin culture region is bordered by the Plateau to the north, California to the west, Southwest to the south, and the Great Plains to the east.

A general chronology of the Great Basin has been developed, however the region exemplifies an Archaic stage for nearly all of prehistory. The following outlines a general chronology of the Great Basin culture region (Neusius and Gross 2007).

- Pre-Archaic: pre-9000 BP
- Archaic: 9000 – 500 BP
- Early Archaic: 9000 – 4000 BP
- Middle Archaic: 4000 – 1500 BP
- Late Archaic: 1500 – 500 BP
- The Protohistoric and Historic period then follows the Late Archaic.

CULTURAL HISTORY

Prehistoric

Pre-Archaic: As in other culture regions, evidence is sparse and scattered for early occupations prior to the Archaic in the Great Basin culture region. Such data are found primarily in the form of isolated fluted points, similar in form to Paleoindian evidence in the Great Plains, on the ground surface, particularly in Utah and the western Great Basin (Jennings 1986; Neusius and Gross 2007). Only one big game kill site has been confidently identified and attributed to this period and that was in Idaho (Jennings 1986). Several important, pre-Archaic sites representing other activities have been found in caves of the region. Other forms of data are less credible and comprised of the bones of extinct animals without direct association to man-made artifacts. The accepted forms of evidence suggest that sheep hunting in the Great Basin culture region has a time depth at least as far back as the pre-Archaic. Additionally, lithic sourcing of tools from this period suggest that mobility and foraging patterns were established at this early time, although they did change throughout time with changes in resource distributions (Neusius and Gross 2007).

Archaic: Much of the early work on Archaic Great Basin occupation focused on cave sites and led to a biased inventory and understanding of the region's prehistory. Once researchers began to focus on other topographic areas, new patterns of distributions and typologies began to surface. Surveys in Surprise Valley of northeast California for instance, demonstrated that semi-subterranean pithouses in substantial base camps were situated in valleys while temporary camps were found in varying settings from lakeshores to mountains.

The Western Pluvial Lakes Tradition developed in during the later years of the pre-Archaic and into the Early Archaic of the western Great Basin between 12,000 and 7000 BP. Sites of this tradition are typically located along pluvial lake margins, such as Lake Mohave in southern California and Lake Lahonton in northern Nevada. However, points associated with this tradition have been found in other environmental settings, suggesting the suitability of their use in other areas. Some researchers believe that the Western Pluvial Lakes Tradition represents adaptations suited to acquiring lakeside or riverine resources left over from the Pleistocene, before the lakes and associated rivers of the culture region dried. Others believe the tradition is a more focused hunting way of life (Neusius and Gross 2007).

In the southwestern Great Basin, the Pinto Period of the Early Archaic developed between 7000 and 4000 BP, immediately following the drying of the region's pluvial lakes. Although generally being seen as subsequent to the Western Pluvial Lakes Tradition, some artifacts of the Pinto Period resemble the form of those attributed to the earlier tradition. This suggests at least some continuity in the region. It should be noted however that several artifact types were added to Pinto site assemblages. The Lahontan Basin includes many Early Archaic sites of this kind. Many are cave sites that were used when water was available in Lahontan Lake. Very few are believed to be residential sites; most were used for burials and caches. Food caches such as these served as forms of storage, eliminated the need for transport, and helped to even out the availability of food across the desert landscape (Neusius and Gross 2007).

The Early Archaic of the eastern Great Basin is divided into three subperiods: Bonneville (11,000 – 9500 BP), Wendover (9500 – 6000 BP), and Black Rock (6000 – 1500 BP). Only a few sites have been found to have been occupied during the Bonneville subperiod. However, what evidence has been found seems to point to a connection to the Western Pluvial Lakes Tradition to the west. Some researchers have suggested that Bonneville sites may represent a transition period between big-game hunting and more plant-oriented subsistence strategies.

More sites have been found and attributed to the Wendover subperiod. Sites are found in a wide variety of environments, indicating a very mobile settlement pattern at this time, likely changing locations with the seasons and using a greater variety of plants. Cave sites from this period include well-preserved plant remains and evidence of the continued use of large game, killed using the *atlatl.*

There was an increase in the number of sites during the Black Rock subperiod corresponding with an increasingly arid environment. There was also a shift in site locations to upland areas that were previously less frequently occupied. It is thought that the changes exhibited during this period can be attributed to the change in climatic conditions of the eastern Great Basin. The Black Rock subperiod extends into and through the subsequent Middle Archaic (Neusius and Gross 2007).

During the Middle Archaic, an increase in the amount of local obsidian in archaeological sites is thought to indicate a decrease in mobility during this period. In southwestern Great Basin the Gypsum Period developed in a climate that was moister, leading to the filling of some desert lakes and extensive marshlands. This was a time of intensive occupation in the Mojave Desert and diversification of subsistence activities. The area east of Barstow in the Mojave Desert has yielded important archaeological sites that have provided data leading to greater understanding of this period. Split-twig figurines are an interesting artifact found in northern Arizona, Nevada, Utah, and California. Made of split twigs, the figurines are of stylized quadrupeds thought to be used in hunting rituals. Rock art depicting quadrupeds and found in the same regions are also thought to be a part of such rituals. The Coso Range is well known for such depictions (Neusius and Gross 2007).

As noted above, the Black Rock subperiod continued from the Early Archaic through the Late Archaic in eastern Great basin. The bow and arrow was introduced in this region during the Middle Archaic years of this period. By the end of this period the region had returned to more moist conditions (Neusius and Gross 2007).

Once the Late Archaic commenced the climate had returned to more arid conditions. In southwestern Great Basin the Saratoga Springs (1500 – 800 BP) and Shoshonean Periods (800 BP – contact) developed. The Saratoga Springs Period is similar to the earlier Gypsum Period, but with smaller projectile points. This is thought to indicate the introduction of the bow and arrow in the region. Various parts of the southwestern Great Basin exhibit influences from their neighboring culture regions during this time. One of the more notable interactions occurred in southern Nevada and southeastern California with the Southwestern Anasazi. Influence of the Anasazi is seen in pottery of the Mojave Desert. Evidence of their physical presence in the region between 1300 and 1100 BP has been found at the turquoise mines of Halloran Spring which were then used by the Hakataya of the Southwest and then the Southern Paiute of the Great Basin (Neusius and Gross 2007).

The Shoshonean Period is marked by the introduction of Desert Side Notched points and brownware pottery. This would be concurrent with the end of the Anasazi occupation of southern Nevada. Trade with coastal people becomes evident. Many Antelope Valley and upper Mojave River village sites appear to have been positioned along trade routes and played a major role in the movement of goods. The Shoshonean Period also marks the spread of Numic speakers out of the southwestern Great Basin. However, there is debate as to whether the Late Archaic Shoshoneans are the same as the Numic-speakers that occupied almost all of the Great Basin at the time of European contact. This is because of a noted discontinuity between ethnographically recorded Numic speakers and the archaeological sites of the Shoshoneans (Neusius and Gross 2007).

In northwestern Great Basin, Rose Springs and Eastgate points, indicating adoption of the bow and arrow, are seen as markers of the Late Archaic. Lithic technology also changed to focus on expedient production of simple flake tools made from local materials. Subsistence activities became more diversified here during this time as more ecological zones and resources were exploited. Additionally, smaller game became increasingly important (Neusius and Gross 2007).

The Late Archaic of the eastern Great Basin is attributed to what is called the Fremont Period. Although Fremont patterns are first seen in the last 100 years of the Middle Archaic the majority of the time it covers (1600 – 700 BP) is in the Late Archaic. Sites attributed to this cultural period are found in the area between southern Idaho in the north, the Colorado River in the south, northwestern Colorado in the east, and eastern Nevada in the west. Generally sites of this area during the Fremont include growth of maize, sometimes associated with irrigation ditches, plain grey ceramics, small-sized projectile points, one-rod-and-bundle coiled basketry, Utah metates, broad-shouldered anthropomorphic figures found as clay figurines or in rock art, and moccasins. Village sites are often comprised of pithouses and adobe architecture and caves were also used for habitation and storage. For some sites, hunting and gathering continued to be a primary source of subsistence rather than concentrating on maize cultivation. It is thought that the people of the Fremont region and period may have combined with the later Numic speakers of the Great Basin, but there is significant evidence that would suggest the Fremont peoples moved into the Great Plains as Numic speakers expanded into the Great Basin (Neusius and Gross 2007).

Influence from both the Southwest and the Great Plains culture regions are often seen in the area of the Fremont. Five regional variants have been identified for the Fremont Period: Uinta, San Rafael, Parowan, Sevier, and Great Salk Lake. The Uinta variant of the Uinta Basin on the Colorado Plateau of northeastern Utah appeared between 1350 and 1050 BP. Sites of this region are characterized by pithouses with isolated storage rooms built on rock ledges being the only aboveground structures. Subsistence focused on hunting small and large game and collecting plants. Uinta Fremont sites are typically located on knolls, buttes, and creek slopes (Neusius and Gross 2007).

The San Rafael Fremont variant is situated on the Colorado Plateau just south of the Uinta variant and east of the Wasatch Range. Sites are typically small, but with the same habitation and storage features, often made of stone, as seen in the Uinta region. Small caves and rockshelters are also sometimes used for storage or habitation. It appears maize occupied a more prominent place in the San Rafael Fremont subsistence spectrum, but wild foods were also important (Neusius and Gross 2007).

To the west of the San Rafael region is the Parowan Fremont in southwestern Utah. Settlements are large and consist also of pithouses and storage features, but here made of adobe. Such sites are typically found on valley floors of the region where water is available. Instead, projectile point styles and several types of bone artifacts distinguish the variant from its neighbors. Like the San Rafael, maize cultivation with irrigation appears to have been central to subsistence practices, but supported with hunting and wild plant gathering (Neusius and Gross 2007).

The Sevier Fremont regional variant is north of the Parowan variant and east of the Uinta variant, in central western Utah and adjacent parts of Nevada. Sites on the eastern edge of the region are thought to have been permanent settlements near marshes while sites in the western portion of the region are thought to have been seasonal sites or camps. The sites in the region of Sevier Fremont are typically small and comprised of a few pithouses with adobe surface rooms. However, architecture and artifact styles are variable throughout the region (Neusius and Gross 2007).

North of the Sevier region is the Great Salt Lake Fremont variant around the Great Salt Lake and north into southern Idaho. Artifact types of this variant differ from those found in other Fremont sites. Most sites of the Great Salt Lake variant were seasonal and lacked masonry. Caves were often used as campsites. Wild crops instead of maize were emphasized along with hunting (Neusius and Gross 2007).

The spread of the Numic speakers into the eastern Great Basin is marked by distinctive brownware pottery and utilization of a variety of wild seeds. Environmental modifications by humans have also been documented, including making bow staves by scoring juniper trees, which would then leave a scar on the tree, and creating controlled burns to promote production of seed plants. Many researchers believe this spread was rapid and began as recently as 950 BP. It would have originated in the southwestern Great Basin culture region in the vicinity of southeastern California, but did not expand into the eastern areas until after Fremont characteristics disappeared. However, the why and how of this spread is not well understood by archaeologists (Neusius and Gross 2007).

Historic

The Great Basin region was one of the last areas to experience contact between Native American populations and Spanish and European explorers. Euroamerican populations were comparatively small following contact so that Native American lifeways were able to continue relatively uninfluenced. The introduction of the horse however brought about some of the most notable changes, similar to other culture regions. The horse allowed for more efficient transportation across the region and into neighboring regions. However, in areas where vegetation was too sparse to support grazing horses, the animals were instead seen as a source of food. European contact did increase somewhat as the fur trade and migrants headed west entered the region. Conflicts were sometimes violent, but often the more important impacts of these contacts were on the productive habitats and traditional subsistence practices of the region (Neusius and Gross 2007).

Euro American Contact

The Great Basin region remained largely unexplored by Europeans until 1776 and 1777 when Spanish priests, Fathers Dominguez and Escalante, explored Utah and the Colorado Plateau. The area was not explored in any major way again until the 1840s, after a long period of nominal Spanish and Mexican rule. The vast arid expanse and lack of conspicuous resources inhibited interest in settlement and development. However, large numbers of settlers and travelers passed through the Great Basin on their way to California or Oregon, especially after gold was discovered in the 1848. The migration of Mormon settlers to Utah beginning in 1846 brought the first large numbers of American settlers to the Great Basin region (Neusius and Gross 2007).

Trade

Mining. The discovery of gold during the historic period first occurred in the Great Basin area in 1859 at the Comstock Lode near Virginia City in Nevada. Silver was discovered in the Humboldt Mountains in 1860 (Neusius and Gross 2007). Mining opportunities of gold, silver, copper, coal, and tungsten spurred immigration to the Great Basin as well as travel through the area on the way to California.

Ranching and farming. Ranching and farming has historically been a strong economic staple to the Great Basin region. Extensive ranching and farming began as an economic alternative to mining. Several legislative acts such as the Homestead Act of 1862, Desert Land Act of 1877, and the Taylor Grazing Act of 1934 attracted setters with the promise of inexpensive land. The Homestead Act alone transferred more than 270 million acres of land from Federal to private ownership (National Park Service 2006). In 1877, the Desert Land Act was passed by Congress to encourage and promote the economic development of the arid and semiarid public lands of the Western United States. Through the Act, individuals could apply for a desert-land entry to reclaim, irrigate, and cultivate arid and semiarid public lands (Bureau of Land Management 2004). The Taylor Grazing Act of 1934 assisted farmers and ranchers in acquiring land or increasing their land holdings through the ability to graze on public lands by way of permit. The Taylor Grazing Act was more favorable to beef ranchers than sheep raisers and cattle ranching became dominant in the region. Ranching continues to be an important economic activity in the region, with public land grazing permits often passed down through families (National Parks Service 2006).

Western Expansion

Treaty of Guadalupe Hidalgo 1848. This treaty was signed in 1848 after the Mexican-American War. The treaty required that Mexico cede 55% of its territory (present-day Arizona, California, New Mexico, and parts of Colorado, Nevada and Utah) in exchange for fifteen million dollars as compensation for war-related damage to Mexican property (Library of Congress 2005).

Boom Towns. When gold miners came to an area in the hope of striking it rich in the mid and late 1880s, many small towns and mining communities sprang up near the mines to service and support the miners. Rapidly built towns consisting of retail stores, hotels, and saloons were established and some were later were abandoned as the mines of the Great Basin were either depleted or gold ran scarce. Remnants of some of these ghost towns of the west still exist as either tourist attractions or state parks (Neusius and Gross 2007).

Railroads. In 1862, President Lincoln signed the Pacific Railroad Act, which allowed construction of a railroad line from Sacramento east, built by Central Pacific Railroad and from Omaha West along the Missouri River, built by Union Pacific Railroad. The rail lines met in Promontory, Utah in 1869, completing the first Pacific Railroad (California State Railroad Museum Foundation 2007; Library of Congress 2006). The majority of the Union Pacific track was built by Irish laborers, civil war veterans, and Mormons who wished to see the railroad pass through Ogden and Salt Lake City, Utah. The Central Pacific track was mostly built using Chinese immigrant laborers. The completion of the railroad meant that agricultural produce, lumber, and gold could be shipped to eastern parts of the US, while settlers were able to emigrate from the east to live in the west. The railroad had a large impact on California immigration, which continued through the 20th century.

<u>*Trails*</u>

Mormon Trail. One of the major forces of settlement in the West was Mormon emigration. Thousands of Mormons (1,600) left Illinois in February 1846, crossing into Iowa, in an attempt to escape religious persecution (Forest Service 2007). Their leader, Brigham Young, opted not to follow the Oregon Trail, but instead forged a new route just north of the Platte River because the route was better suited to wagon travel and because he wished to avoid other travelers from Missouri who frequented the Oregon Trail (Billington 1963). The Mormons crossed Mississippi and established temporary headquarters there, then went on to Missouri, through the Great Plains, where they spent an icy winter and lost 600 people from their party (Billington 1963). They reached the Valley of the Great Salt Lake, where they settled, in June 1847.

Old Spanish Trail. This trail was first established by a Mexican trader, Antonio Armijo, in 1829. He traveled from New Mexico to Los Angeles on a commercial caravan, carrying Mexican woolen goods and planning to bring horses back from California (National Park Service 2007). Prior to the Old Spanish Trail, an established overland southern route to California from New Mexico did not exist although portions of the trail had been used by Native Americans and early traders. The trail runs through present-day Colorado, Utah, Arizona, Nevada, and California (Cultures and Histories of the American Southwest 2007).

California Trail. The trail was used by over 250,000 farmers and gold miners from Missouri during the 1840 and 1850s. The route starts along the Missouri River, and then converges on the Great Platte River Road, overlaps with the Oregon Trail and to the Rocky Mountains. After the crossing the Rockies, many routes were used to get to and cross the Sierra Nevada Mountains. The total system of trails and alternate routes that make-up the California Trail is approximately 5,664 miles (National Park Service 2007).

Nez Perce. This trail extends from Wallowa Lake in Oregon to Bear Paw Mountain in Montana. It is named for the Nez Perce tribe of Native Americans who fled their lands when the US Army pursued them in 1877. Approximately 750 Nez Perce men, women, and children traveled over 1,170 miles through the mountains, on a trip that lasted from June to October of 1877 (US Forest Service 2007). The trails extends from Wallowa Lake, Oregon, through the Snake River at Dug Bar, entering Idaho at Lewiston and then over to north central Idaho, entering Idaho at Bannock Pass and traveling back to east Montana at Targhee Pass to cross the Continental Divide. It bisects Yellowstone National Park in Wyoming, and then follows the Clark Fork River out of Wyoming into Montana. The trail then heads north into Bear's Paw Mountains and ends forty miles from the Canadian Border (US Forest Service 2007). This trail crosses 90 miles of BLM land and 221 miles of USFS land within the project area.

GREAT PLAINS

The area between the Saskatchewan River in the north, the Rio Grande in the south, the foothills of the Rocky Mountains in the west, and the upper Mississippi River valley in the east makes up the Great Plains culture region (Figure 3-18). In general, the area covers parts of southern Alberta, Saskatchewan, and Manitoba in Canada and in the US, parts of Montana, Wyoming, Colorado, Texas, Oklahoma, Missouri, Iowa, and Minnesota, far eastern New Mexico, and all of North Dakota, South Dakota, Nebraska, and Kansas. The majority of this culture region is east of the planning area (DeMallie 2001; Neusius and Gross 2007); planning area states within the Great Plains culture region include eastern areas of Montana, Wyoming, and Colorado (the easternmost planning area in New Mexico is included in the Southwest culture area). These areas are considered to be a part of the Northwestern and Western Periphery/western Central subunits of the Great Plains region (Gunnerson 2001; Frison 2001; Neusius and Gross 2007). The cultures of the Great Plains region are quite varied, primarily due to the diverse environs it covers. Different environments require unique adaptations by the occupants. However, all cultures of the Great Plains regions have at least one trait in common and that is bison hunting

USFS regions included in the Great Plains region include portions of Regions 1 and 2. BLM Field Offices included in the region include all or portions of Miles City, Bilings, Malta, Glasgow, Lewistown, Havre, Butte, Casper, Buffalo, Newcastle, Rawlings, and Royal George offices.

Table I-4 identifies the Great Plains culture region languages and tribes that have been documented within the project area. Culturally, the Great Plains culture region is bordered by the Plateau, Great Basin, and Southwest regions on the west and the Northeast and Southeast on the east.

Table I-4
Languages and Tribes of the Great Plains Culture Region in the Project Area

Language (Linguistic Phylum)	Tribes
Siouan (Macro-Siouan)	Assinibone, Crow
Algonquin (Macro-Algonquian)	Cheyenne, Gros Ventre, Arapaho
Uto-Aztecan (Aztec-Tanoan)	Comanche

Source: DeMallie 2001; Goddard 2001; Waldman 2000

A general chronology of the Great Plains has been developed based on developments in lithic technology with some regional variations and intermediate lithic forms between traditions (Neusius and Gross 2007). The earliest evidence of occupation of the Great Plains may represent the pre-Clovis period, however evidence is scant. The most definitive evidence for early occupation occurs during the Paleoindian Period, comprised of the Clovis and Folsom Periods. The following outlines a general chronology of the Northwest and Western Periphery/western Central subregions of the Great Plains (Neusius and Gross 2007).

- Pre-Clovis: pre-11,500 BP

- Paleoindian: 11,500 – 8500 BP
- Archaic: 8500 – 1500 BP
- Early Archaic: 8500 – 5000 BP
- Middle Archaic: 5000 – 3500 BP
- Late Archaic: 3500 – 1500 BP
- Late Prehistoric: 1500 – 500 BP
- The Protohistoric and Historic periods then follow the Late Prehistoric.

CULTURAL HISTORY

Prehistoric

Pre-Clovis: As stated above, there is very scant evidence for human occupation of the Plaines prior to 11,500 BP. Primarily, this evidence is in the form of bone breakage patterns and a few tools. Even these are sometimes questionable in their linkage to humans. Although there are a number of mammoth bone sites it is difficult to attribute these to human activities. The patterns of breaks in the bones and their distributions suggest an association with humans, but the sites either have few or no stone tools. As such, a pre-Clovis occupation of the Great Plains is not well established at this time (Neusius and Gross 2007).

Paleoindian: There is considerable more evidence of Clovis and later Paleoindian occupations of the Great Plains region. In fact, it is in the Great Plains that archaeologists first encountered evidence of a Paleoindian occupation of the US. There are two definitive subperiods of this time based upon distinct forms of projectile points that are assumed to represent temporally and possibly spatially distinct populations. These are Clovis (11,500 – 10,900 BP) and Folsom (10,900 – 10,200 BP). The style of Clovis points is found in strata below those of Folsom points throughout the region. There are several point styles found in specific sub-areas that are viewed to be area-specific transitional styles that occurred between the periods of Clovis and Folsom points. The style of Plano points, comprised of unfluted lanceolate, stemmed, and unstemmed projectile points, represent lithic technologies of the Late Paleoindian period. Again, there is regional variation of lanceolate point styles. Between 9000 and 8500 BP a larger variety of lanceolate points is found, denoting a transition to the Archaic period and perhaps could be called a Terminal Late Paleoindian Period (Neusius and Gross 2007).

Combined with other tools in the Paleoindian toolkit, these projectile points suggest an emphasis on hunting and the use of high-quality raw materials suggest the importance of quality and reliability in the tools (Neusius and Gross 2007). In the foothill-mountain groups of the northwestern subregion, materials were typically extracted from local sources. Additionally, projectile points were not as important as in other subregions, possibly reflecting the use of different procurement strategies adapted specifically to this area (Frison 2001). Caches of blades and bifaces found in the region, such as the Anzick Cache in Montana, do indicate an overall importance placed on lithics. Some of these are even associated with burials (Neusius and Gross 2007).

However, the majority of Great Plains Paleoindian sites are large game kill sites. Clovis points are most often associated with mammoth kill sites, although other large game is also found. Bison hunting appears to have begun with Folsom points, probably due to the environmental conditions of the time creating stable grasslands for the bison to roam in. Bison hunting strategies were carried out by individuals as well as small and large groups. Ambushes conducted at springs and playa lakes appear to have been the most common during the Folsom period based on archaeological evidence. Later bison drive, trap, and jump sites, such as the Jones-Miller site in east Colorado, became more common (Neusius and Gross 2007). It should be noted however that bison was not the only meat package used by the Great Plains Paleoindians as some sites contain a diverse faunal assemblage (Frison 2001).

Overall, archaeological evidence indicates that the Great Plains Paleoindians existed in small, mobile bands that ranged between the mountains and high plains. There is debate however as to whether these were specialized or general hunter-gatherers. Additionally, the archaeological record is biased toward large kill sites, such as those described above (Neusius and Gross 2007). Very few non-kill sites are represented in the record resulting in a gap in our knowledge of the region during this period. Similarly, the adaptations of the foothill-mountain groups of the northwest subregion are not as well known as other Great Plains groups. Further study of sites in the northwest would provide a better understanding of the niche adaptations that occurred here (Frison 2001).

Archaic Period: Subsistence and settlement patterns are basically the same during the Archaic Period of the Great Plains as they were during the Paleoindian Period. The period is denoted by a change in lithic technology, namely a replacement of lanceolate points by notched points across the Great Plains (Neusius and Gross 2007). The most notable change indicating the Archaic is the development of horticulture, also called "Woodland," around 2500 BP. This occurred primarily in the eastern portions of the Great Plains region while the west and northwest remained mostly reliant on large game hunting. In the Northwestern as well as in the western Central Great Plains, however, there is a continuation of mobile hunting and gathering cultures (Frison 2001), hence the term "Hunting and Gathering Tradition" alternatively used to refer to this period. Groups established a seasonal settlement pattern that adjusted to conditions. They also established a flexible social organization to allow for aggregation of bands during hunts (Neusius and Gross 2007).

The Early Archaic is represented by more cave and rockshelter sites than open sites, presumably due to unusual environmental conditions during this time (Frison 2001). Grinding implements such as manos and metates were developed during this period of Great Plains occupation as well as earthen fire pits. These developments reflect an increased emphasis on vegetal foods (Frison 2001; Neusius and Gross 2007). This is also when horticulture developed in the river valleys and the Eastern Great Plains, although not in the Northwest and western Central Great Plains. In this area, faunal remains are scarce; however there are still a few bison kill sites in limited areas as well as evidence of communal hunting (Frison 2001). Throughout the Archaic, such sites are typically associated with arroyos, sand dunes, steep bluffs, or artificial corrals (Neusius and Gross 2007), remains of which may still be present. The large side-notched projectile point is the typical diagnostic marker for the Early Archaic in Northwest Great Plains (Frison 2001; Neusius and Gross 2007). However, in the western Central Great Plains, corner-notched points are prevalent (Frison 2001). The evolution from Paleoindian lanceolate points to notched points may indicate the new use of the *atlatl* by hunters (Neusius and Gross 2007) or it could represent the local development, transmission of outside ideas and technology, or population movements (Frison 2001). In either case, caching of lithic tools such as these does appear to continue on from the Paleoindian period (Frison 2001).

Although there is definitive evidence of housepits at Early Archaic sites, often associated with storage pits (Neusius and Gross 2007), there are not a significant number of sizable occupations in Northwest and western Central Great Plains, with the exception of caves and rockshelters (Frison 2001). However, there is no doubt that Early Archaic peoples existed here given the common surface finds of diagnostic artifacts. The apparent lack of large cultural occupations should not be attributed to a lack of human population, but may be related to site preservation and population mobility (Frison 2001). Similarly, the higher incidence of sites in caves and rockshelters may simply be due to their excellent preservation conditions.

The Middle Archaic saw many of the Early Archaic characteristics carry on, including grinding tools, fire pits, and numerous occupations of caves and rockshelters, especially along the Bighorn and Absaroka Mountains of Wyoming and Montana, respectively. Many of these sites have little to no stratigraphic separation between deposits of the two subperiods, indicating continuous occupations. Alterations in projectile point styles are the most notable Middle Archaic diagnostics. McKean and Mallory type projectile points are the diagnostic styles that occur throughout the Northwest Great Plains; McKean points also occurring in the western Central Great Plains.

Bison remains become more frequent and bison jumps are still present, but vegetal foods also continued to be consistently represented in people's diets. Overall, the subsistence base during the period of McKean points would indicate a strategy adapted to ecotones that provided the most variety of resources (Frison 2001).

Changes in point form, particularly the appearance of the Pelican Lake corner-notched projectile point, indicate Late Archaic sites in the Northwest Great Plains (Frison 2001). It is thought that some Late Archaic points are small enough to have functioned as arrow points (Neusius and Gross 2007), the bow and arrow becoming prevalent in the subsequent Late Prehistoric Period. Little in subsistence strategies changes between the Middle and Late Archaic periods. Caves and rockshelters of the Big Horn Mountains and northern Wyoming still yield Archaic archaeological sites of this time period, including perishable materials such as basketry (Frison 2001).

Late Archaic peoples expanded further into the intermontane basin interiors as well as the foothills and mountains of the western Great Plains during the Late Archaic. This is indicated by fire pits, which at some sites can cover hectares and at others just a single pit will be found. The pits, often characterized by perimeters of red oxidized clay due to heat exposure or stone linings, are associated with other features and artifacts such as boiling pits, grinding stones, and flake tools. Although some of these were most certainly used for cooking, some were also probably used for a source of heat within structures. Prehistoric lakeshores created by retreating glaciers were often used for Archaic occupations. Many of these have been affected by modern efforts for water storage. These Archaic lifeways in the Northwestern and western Central Great Plains regions, concentrating on vegetal resources, continued into the Late Prehistoric period, while in other more "plainslike" environments economies were oriented more toward bison hunting (Frison 2001).

Stone rings, one of the most characteristic artifacts of the Late Prehistoric period on the Northwest Great Plains, first began to occur in large quantities during the Late Archaic. Raised topographic features in the interior basins and plains as well as in the foothills are the most sensitive for these kinds of sites, including butte tops, barren ridges, minor topographic rises, and stream terraces, particularly cobble-filled terraces. The rings occur singly or in clusters and vary in diameter. Association with cultural refuse is rare, making dating difficult in some cases (Frison 2001). Functions attributed to these rings range from structure bases, such as tepee rings, to ceremonial, such as medicine wheels (Frison 2001; Neusius and Gross 2007). Other features attributed to the Late Archaic, but are also difficult to date include petroglyphs, pictographs, and stone cairns and lines (Frison 2001).

Late Prehistoric Period: Dependence upon bison hunting, pottery making, and use of the bow and arrow combine to characterize the Late Prehistoric Period. In general, however the adaptive strategies of previous times continued into the Late Prehistoric. This period occurred concurrently with the Great Plains Woodland and Great Plains Village Periods of the majority of the Great Plains cultural region to the east of the project area. Some of the historically documented Great Plains tribes can be documented by the archaeology of the region during this time (Neusius and Gross 2007).

Historic

Initial European contact with Great Plains tribes occurred first in the Southern and Central Great Plains. The Great Plains regions of the project area continued to support mobile bison hunters while further east several migrations and relocations occurred creating a tangled history of movement in those areas. Such movements represent the fluidity of the Great Plains Native American cultural geography during the Historic Period (Neusius and Gross 2007).

Three other factors contribute to the historic character of Native Americans in the Great Plains: introduction of the horse, trade in European goods, and disease. The horse allowed extended trade through the increased mobility that it brought, impacting economies and intergroup relations. Social structures were also impacted as individuals sought to gain more of these luxury items. The increased mobility brought by the horse also impacted political tribal relations as groups traveled farther into neighboring territories, often resulting in increased violence and raiding. Trade in European goods, guns in particular, also contributed to the increased violence. Europeans also brought Native Americans into their trades, including the fur trade. European diseases, however, decreased Native American populations, forced migrations and created changes in settlement patterns, as well as political breakdowns and unions (Neusius and Gross 2007).

Euro-American Contact

The first European explorers to explore the Great Plains came from Spain and France by way of three routes: the Spanish came to the Southern Plains and were explored by Alvar Nunez Vaz de Vaca from 1528 to 1536 across Texas. The Central Plains was explored by Francisco Vasquez de Coronado, who came to the Great Plains region (present day Texas and Kansas) in approximately 1540-1542. Coronado explored present-day Arkansas, New Mexico, Colorado, Kansas, and Nebraska. The Northern Plains was explored by Pierre Esprit Radisson and Medard Chouart, from France in 1659. Alvar Nunez de Vaca crossed Texas and parts of northern Mexico from 1528 to 1536 (Swagerty 2001). The French also explored area between 1742-1743, passing through North Dakota, Wyoming and Montana.

Euro-Americans began taking more of an interest in the Great Plains area after the Louisiana Purchase in 1803. The Lewis and Clark Expedition of 1804-1806 included present-day Missouri, South Dakota, North Dakota, Montana and other areas in the west. Fur and hide trading was one of the results of exploration of the area, and was the reason thousands of Europeans came to the Great Plains (Scott 1952). The Great Plains region continued to support mobile Native bison hunters while further east several migrations and relocations occurred creating a tangled history of movement in those areas (Neusius and Gross 2007).

Trade

Fur Trade. The fur trade was an attractive economic pull for settlers to the Great Plains area. Trappers and traders from France, Spain, Russia, Britain and US came to the region to trade furs and hides. Native American tribes acted as middlemen and indirectly traded with other tribes and societies (Neusius and Gross 2007). After Lewis and Clark's exploration of the area, Americans also established trading posts within the Great Plains. Much of the trade industry began in the northern portion of the Great Plains with Hudson's Bay Company and the American Fur Trading Company. The French established trading posts there as well (Swagerty 2001). The Hudson's Bay Company controlled most of the trade in areas that drained into the Hudson Bay, including North Dakota and Minnesota as well as the Canadian portion of the Northern Plains. The French traded on the tributaries of the Mississippi, or west from the Great Lakes, where they established posts along the rivers (Neusius and Gross 2007). This prosperous trade lasted from 1806 to 1850, and included trappers from France, Spain Brittan, Russia and the United States. Construction of trading posts lasted from 1822 until 1850, when supply and demand for beaver fur ended.

Ranching. Ranching on the Great Plains developed initially using the open range lands where cattle were free to roam without fences or barriers. In most areas land was not surveyed, settled or fenced. The lack of forests and trees also made it difficult to build fences to control livestock. The commercial development of barbed wire in 1870 was instrumental in providing fencing material for cattle, which enabled ranchers to separate their cattle and control grazing (International Information Programs 2007 and Webb 1931). The use of open ranges continued in some places into the 20th century.

After the Civil War, railroads were used to transport cattle to eastern and northern markets. Cattle were driven hundreds of miles along established routes overland to railroad towns like Abilene, Kansas. The industry grew steadily as Native populations were displaced, more land became available for settlement, and more rail transportation was developed. The last brief boom in the ranching economy occurred in the early 1880s when there was a large influx of ranchers that settled in the region (Webb 1931). Soon after drought, harsh winters, overgrazing, and competition resulted in disastrous setbacks for the ranching industry, which began to collapse in the mid-1880s (Webb 1931). Ranching continues to be an important economic mainstay in many parts of the Great Plains region.

Mining. Gold, silver, and copper mining were important resources within the Rocky Mountain States of the Great Plains in the nineteenth century. Energy resources such as petroleum, natural gas and coal are currently important resources in the Plains (USDS 2008).

Western Expansion

Hide hunters and trappers were first attracted to the region because of the large numbers of bison in the area. A prosperous fur trade took place in the early decades of the nineteenth century, which led to the eventual depletion of the bison population. Early American emigrants came to the Great Plains region in larger numbers beginning in 1840, many passing through on their way further west. Gold discovered in Colorado, Montana and California greatly increasing overland travel. In 1850 alone, 100,000 emigrants crossed the Great Plains, many bound for the gold fields of California (Swagerty 2001). Permanent settlement in the Great Plains was avoided because of the lack of trees, water sources, and difficultly in producing crops (USDS 2008). Many crops failed in the Great Plains largely due to rainfall fluctuation in the region, and the marginal quality of farming lands. Early settlers often bypassed the Great Plains region in order to settle in areas more hospitable to farming (USDS 2008). Those that did settle in the region had more success with ranching, an alternative to farming.

In 1854, Congress passed the Kansas-Nebraska Act, which created the Kansas and Nebraska Territories. The acquisition of lands originally held by Native Americans expanded the boundaries of the United States west of the Mississippi. The Homestead Act of 1862 attracted setters, many of whom were recent immigrants from Europe. The Homestead Act transferred more than 270 million acres of land from Federal to private ownership. Large numbers of homesteaders settled in the Great Plains, especially the western portion. Many of these new settlers tried to establish farms and homesteads that failed due to the poor suitability of the land for agriculture. Extensive irrigation in the area eventually led to productive crop growing, and livestock raising was consistently part of the area's economy (National Park Service 2006).

<u>Trails</u>

Oregon Trail. The Oregon Trail was used by settlers traveling to the Great Plains region or to pass through the area on their way to more westerly points. The Trail began as an unconnected series of trails used by the Native Americans. Fur traders expanded the route to bring pelts to trading posts in the early 1800s (Bureau of Land Management 2007). The route extends roughly 2,000 miles west from Missouri toward the Rocky Mountains to the Willamette Valley. A trail to California digressed from the route in Idaho (Bureau of Land Management 2007).

Several groups followed the route to settle the west between 1800 and 1880s. Missionaries used the trail during the 1830s, traveling along the Platte and Snake Rivers to settle churches in the Northwest. Mormons, headed toward Salt Lake in Utah, used the trail beginning in 1847, and the discovery of gold in California caused many gold miners to use the trail in 1849. Military posts and spur roads were established along the Oregon Trail. Fort Laramie in Wyoming was established in 1849 as the base for protecting a long stretch of the Oregon Trail (National Park Service no date). The trail was used for driving cattle driving trail eastward for a brief time as well. The construction of the Central Pacific Railroad, connecting California to the rest of the continent in 1869, decreased use of the Oregon Trail. By the early 20th century, the trail was no longer a major transportation corridor, as railroad lines paralleled the original route in many places (Bureau of Land Management 2007, Schwantes 1989).

Mormon Pioneer Trail. One of the major forces of settlement in the West was Mormon emigration. A large colony of Mormons left Illinois in February 1846 and crossing into Iowa, in an attempt to escape religious persecution (Forest Service 2007). Their leader, Brigham Young, opted not to follow the Oregon Trail, but instead forged a new route just north of the Platte River because the route was better suited to wagon travel and because he wished to avoid other travelers from Missouri who frequented the Oregon Trail (Billington 1963). The Mormons crossed Mississippi and established temporary headquarters there, then went on to Missouri, through the Great Plains, where they spent an icy winter and lost 600 people from their party (Billington 1960). They reached the Valley of the Great Salt Lake, where they settled, in June 1847. The trail is approximately 1,300 miles long (American West 2007).

Nez Perce. This trail extends from Wallowa Lake in Oregon to Bear Paw Mountain in Montana. It is named for the Nez Perce tribe of Native Americans who fled their lands when the US Army pursued them in 1877. Approximately 750 Nez Perce men, women, and children traveled over 1,170 miles through the mountains, on a trip that lasted from June to October of 1877 (US Forest Service 2007). The trails extends from Wallowa Lake, Oregon, through the Snake River at Dug Bar, entering Idaho at Lewiston and then over to north central Idaho, entering Idaho at Bannock Pass and traveling back to east Montana at Targhee Pass to cross the Continental Divide. It bisects Yellowstone National Park in Wyoming, and then follows the Clark Fork River out of Wyoming into Montana. The trail then heads north into Bear's Paw Mountains and ends forty miles from the Canadian Border (US Forest Service 2007). This trail crosses 90 miles of BLM land and 221 miles of USFS land within the project area.

<u>*Railroads*</u>

*T*he construction of the Union Pacific and Central Pacific Railroad, linking Missouri to California was completed in 1869. These completed railroad lines increased settlement in the Great Plains area from emigrants from the eastern US. The rail lines not only transported people, but was also used to transport hides and cattle to markets in the east (National Park Service 2007). Many of these lines were constructed in an east-west direction instead of a north-south direction because early travelers were merely passing through the region, not settling there (Webb 1931). An important exception was the Kansas Pacific

Railroad from Abilene to Chicago which established in 1867 a gateway for cattle from the southern plains to reach eastern consumer markets through the stockyards of Chicago.

The construction of the railroads often required temporarily quarters for the construction crews to inhabit while they built stretches of railroad. These towns would consist of large tents that held dance floors, gambling areas, dance floors and bars. Many of the rural "boom towns" eventually became ghost-towns due to a loss of population and because much of the agricultural land was unsustainable (Billington 1963). However, many towns and cities within the Great Plains region have their origins in the small boom towns associated with railroads line. Some of these cities continue to be important to the economy of the Great Plains (USDS 2008).

CALIFORNIA

The California culture region resembles the modern state, however it excludes parts of the northwest and northeast corners of the state (Northwest Coast and Plateau culture regions, respectively), as well as the Mojave Desert and areas east of the Sierra Nevada (Great Basin culture region) (Figure 3-16). The region does extend south into Mexico and Baja California, but since these areas are not included in the project area, it is not discussed here. Although the region is not consistently split into subregions, the terms Southern California, Central Coast, and Northern California are used here (the Central Valley is not discussed because it is mostly excluded from the potential development area). Southern California is considered to include the area south of Santa Barbara; the Central Coast is covers primarily Santa Barbara, San Luis Obispo, and Monterey Counties; and Northern California is considered to be the area from the San Francisco region north.

USFS regions included in the California region include all of Region 5 and a small southern portion of Region 6 in Oregon. BLM Field Offices included in the region include all or portions of the El Centro, Palm Springs/South Coast, Barstow, Needles, Ridgecrest, Bakersfiled, Hollister, Folsom, Ukiah, Eagle Lake, Redding, Arcata, Alturas, Surprise and Lakeview offices.

Table I-5 identifies the California culture region languages and tribes that have been documented within the project area. Culturally, the California culture region is bordered by the Southwest and Great Basin culture regions to the east and the Plateau and Northwest Coast culture regions to the north.

A general chronology of California has been developed based on developments in social organization and bead forms (Neusius and Gross 2007). The early prehistory of California has been dramatically affected by post-glacial sea level

Table I-5
Languages and Tribes of the California Culture Region in the Project Area

Language (Linguistic Phylum)	Tribes
Athapascan (Na-Dene)	Tolowa, Hupa, Chilula, Whilkut, Mattole, Nongatl, Sinyone, Lassik, Wailaki, Cahto
Algonquian (Macro-Algonquian)	Yurok, Wiyot
Uto-Aztecan (Aztec-Tanoan)	Tubatulabal, Tataviam, Gabrielino, Luiseño, Kitanemuk, Serrano, Cahuilla, Cupeño
Karok (Hokan)	Karok
Chimariko (Hokan)	Chimariko
Shastan (Hokan)	Shasta
Palaihnihan (Hokan)	Achumawi, Atsugewi
Pomo (Hokan)	Western Pomo, Northeastern Pomo, Eastern Pomo, Southeastern Pomo
Yanan (Hokan)	Yana
Esselen (Hokan)	Esselen
Salinan (Hokan)	Salinan
Chumashan (Hokan)	Eastern Coastal Chumash, Obispeño Chumash, Purisimeño Chumash, Interior Chumash
Yuman (Hokan)	Tipai and Ipai
Miwok-Costanoan (Penutian)	Lake Miwok, Eastern Miwok, Coast Miwok, Costanoan
Wintun (Penutian)	Wintu, Nomlaki, Patwin
Maidu (Penutian)	Maidu, Nisenan, Konkow
Yokutsan (Penutian)	Monache, Southern Valley Yokuts, Northern Valley Yokuts, Foothill Yokuts
Yukian (Undetermined linguistic phylum)	Yuki, Coast Yuki, Huchnom, Wappo

Source: Heizer 1978a; Shipley 1978; Neusius & Gross 2007; Waldman 2000

rise, resulting in inundation of the coastline and altering coastal environments. Although a few sites have been attributed to Pre-Clovis occupations, many archaeologists do not agree these are true representations of a very early occupation of California. Rather, the earliest agreed upon evidence is for a Clovis-like occupation. The following outlines the general chronology of California (Neusius and Gross 2007). It should be noted that this chronology is not based on the summary regional chronology given in the standard *Handbook of North American Indians* (Heizer 1978b), but is instead based on more recent archaeological data.

- Paleoindian: pre-11,000 BP

- Archaic: 11,000 – 4000 BP
- Early Archaic: 11,000 – 8000 BP
- Middle Archaic: 8000 – 6000 BP
- Late Archaic: 6000 – 4000 BP
- Pacific: 4000 – 500 BP
- Early Pacific: 4000 – 2500 BP
- Middle Pacific: 2500 – 1500 BP
- Late Pacific: 1500 – 500 BP
- The Historic period then follows the Late Pacific Period.

CULTURAL HISTORY

Prehistoric

Paleoindian: The most accepted evidence of first cultures in California is comprised of Clovis-like fluted points found primarily as surface scatters. As in other regions however, such finds are rare (Neusius and Gross 2007). Their scarcity may be due to the rise of sea level at the end of the Pleistocene. Consequently any sites formed during the Paleoindian period along the now submerged coastline, would also be submerged.

Evidence from one archaeological site, Borax Lake, in the North Coast Range of northern California supports a notion that early inhabitants of the northern region were generalized foragers, opposed to the big-game hunters of other regions. Other sites in the southern California region include lithic hunting and cutting tools, and lack millingstones, indicating an emphasis on large game hunting. A series of Paleoindian sites are located along the California coast and are associated with coastal rivers, lagoons, and estuaries. These sites indicate a possible early maritime adaption that is separate from the Clovis-like occupations. Fluted points are not found at these sites. Also indicated is a use of watercraft suitable for ocean crossings, given the location of some sites on the Channel Islands of the Santa Barbara region (Neusius and Gross 2007).

Archaic: The Archaic period witnessed warmer and drier conditions that required adaptations by prehistoric populations in the California culture region. However, Early Archaic sites were most certainly affected by rising sea levels, becoming inundated by rising sea levels or eroded from cliffs by wave action. The period saw a slow, but necessary evolution of subsistence activities, beginning with hunting, followed by an emphasis on seed collection, followed by a variety of specializations adapted to the range of environments in the region (Wallace 1978).

Archaic adaptations included the incorporation of seeds into the diet, requiring development of millingstones. Along the coast in southern California, many Archaic sites incorporate numerous amounts of shell with simple flake and cobble tools as well as manos and metates. However, many inland southern California sites include many more flaked stone tools and often not made from cobbles, like those along the coast, and they lack shell. Along the Central Coast in the Santa Barbara region some pithouses have been attributed to the Archaic and mortars and pestles appear rather than metates. In the San Francisco Bay region the earliest times of the Archaic period are poorly represented, probably due to sea level rise creating for the Bay for the first time (Neusius and Gross 2007). As such, the area may not have been resource-rich prior to sea level rise. In the same thought, any sites that would have been in the Bay would now be underwater. Archaic sites that are present in the San Francisco Bay region exhibit the same millingstone tool kit as other areas, as well as mortars and pestles and simple shell beads. Along the coast north of San Francisco Bay the Borax Lake tradition is prominent. This tradition is based on the presence of a distinctive projectile point with a square stem, millingstones, mortars, pestles, simple lithic tools, knives and bifaces (Neusius and Gross 2007). Additionally, charmstones, presumably of ceremonial significance, are found throughout the culture region during this period.

Patterns of settlement during the Archaic period are best known from the archaeological record of Southern California. During the earliest period of the Archaic prior to sea level rise, sites were situated along the coast on higher ground, such as bluffs and marine terraces. As sea levels rose, the sites became concentrated on such topographic features near the forming lagoons and estuaries. However, it is unknown if these are true cultural patterns or if it is a biased pattern formed as a result of site inundation along the coast (Neusius and Gross 2007). As sea levels continued to rise during the Archaic, sediments carried down streams and rivers to the ocean began to fill the lagoons and estuaries that had formed at their mouths. The result for some was the formation of mudflats while others were entirely cut off from the ocean, depleting their original productivity. Late Archaic populations adapted to these changes by moving to the open coast and permanent bays and wetlands. In Southern California, sites along the coast acted as seasonal base camps while inland sites were occupied only for parts of the year. Such a pattern indicates small, highly mobile groups. Alternatively, along the Central Coast there are large base camp sites along the coast accompanied by a variety of smaller, season al camps more inland. This pattern indicates a semi-sedentary lifestyle (Neusius and Gross 2007).

The earliest Archaic peoples made great use of the varied environments of California in their diets. Along the coast shellfish were favored and supplemented by seeds and land mammals, but surprisingly fish is not as common in archaeological sites as would be expected. Millingstones appeared in earnest along the coast around 8000 – 9000 BP, indicating intense use of seeds. Meanwhile in more inland areas large game and seeds were the staples of diets there. In the Middle Archaic, hunting became increasingly more important throughout the culture region. There is also an increase in incidence of mortars and pestles during the early part of Late Archaic, indicating increased use of acorns (Neusius and Gross 2007).

Pacific: The Pacific Period is similar to other post-Archaic patterns in North America. Stable food supplies were adopted and economies developed that were based on those supplies. Populations grew and developed social hierarchies as a reaction to the imbalance of the population and available resources. An increased importance on trade in specialized and luxury items helped to maintain the developing hierarchy. In coastal and southern California cultural time periods during the Pacific are based primarily on changes in shell bead and ornament typologies (Neusius and Gross 2007).

A variety of sites characterize the Pacific Period, namely permanent villages, seasonal camps, specialized resource procurement sites (such as quarries) that replaced the more generalized camp sites of the Archaic, rock art sites, and trading sites. Populations were sedentary primarily in the Santa Barbara region, while in other parts of the project area they were semi-sedentary with permanent villages and seasonal base camps. For instance, along the northern coast semi-sedentary villages were established in the lowlands and camps in the uplands, the latter occupied by a portion of the village population. Often, bedrock milling features (such as bedrock mortars and grinding slicks) are associated with many of the sites of the Pacific Period (Neusius and Gross 2007), further indicating the importance of seeds and other vegetal foods.

Along the coast shellfish remained an important part of the prehistoric diet and the importance of fishing apparently increased. Along the Central Coast hunting of marine and land mammals supplemented this diet, while in the south acorns and seeds were more common supplements (Neusius and Gross 2007). The increase in fishing may have been supported by new technologies in watercraft, such as the *tomol*, or plank canoe. It should be noted that ocean going watercraft apparently were in use during the Early Archaic given the location of sites on the Channel Islands.

With the intensification of stable resources such as acorns, hard seeds, fish, and marine resources, the development of storage became a requirement. Acorn granaries are in fact a prominent feature of most California sites. In the desert areas of Southern California, acorns were often replaced with honey and screwbean mesquite. In the areas farthest south ceramic vessels were commonly used for storage rather than granaries (Neusius and Gross 2007).

Later in the Pacific Period artifacts begin to be elaborated with engraving and shell ornamentation along the coast. The numbers of groundstone artifacts such as millingstones, mortars, and pestles, increases there is extensive use of marine resources. Additionally small arrowheads are found in sites. Along the south coast and in the southern foothills and mountains sites have a more diverse assemblage, including ceramics, triangular and side-notched arrowheads, mortars, metates, and manos. Evidence of cremation is also present at sites, whereas during the Archaic individuals were commonly buried. The practice of cremation along with similarities in artifact styles seem to indicate interaction between this southern portion of the California culture region and parts of the Southwest region. Likewise, along the northern coast of California, similarities are seen in the settlement patters of the northern California coast and the adjoining Northwest Coast region, likely indicating interactions between the two areas (Neusius and Gross 2007).

The use of the plank canoe not only allowed people of the Pacific Period to venture farther out for fishing, but also allowed interdependent economic systems to develop between the mainland and islands. This, along with the increased population indicated by larger sites (Neusius and Gross 2007), only further developed the social hierarchies of settlements. Those with resource surpluses could afford to have canoes built and could therefore exercise control of trade along the California coast, continuing to attain and control luxury and specialized items, such as the *Olivella* shell beads used for money and made using lithic materials available only on Santa Cruz Island in the Santa Barbara Channel.

Historic

Contact with a variety of European ethnicities brought exotic goods such as glass beads, china, and iron to the California region, as well as the diseases that were brought in the same way to other cultural regions. The decrease in California populations as a result of European diseases most certainly affected the social organization and subsistence activities of the people (Neusius and Gross 2007).

As the Spanish established missions, pueblos, and presidios across the region, missionaries sought to convert the Native Americans to Christianity and settle them at the missions. Missions were established in areas with large Native American populations and where water and other resources were readily available (Neusius and Gross 2007). Some Native Americans did move to the missions, assisting with the construction of the missions and their systems (such as irrigation), others did not. Uprisings of Mission Indians are recorded as some realized that they did not want to stay at the missions. The Mission life was much different than what native groups were used to, however studies have shown that female activities continued relatively unchanged, while male activities resembled more Spanish-derived pursuits (Neusius and Gross 2007).

After Mexico gained independence from Spain, much of the land of California was transferred to private ownership in the form of ranchos and haciendas; however, the Spanish pueblos also grew. The presence of Native Americans at these locations varies across the state. At some, there is no evidence of their presence, while at others there is evidence of their use as laborers (Neusius and Gross 2007).

Euro American Exploration

The first known Europeans to explore the area that became California were the Spanish, British, and Russians.

Spanish exploration of the California region began in the sixteenth century. Francisco Coronado and Hernando de Alarcon, along with Melchor Diaz led expeditions in 1540. Juan Rodriguez Cabrillo, from Spain, led an expedition to the region in 1542 (Castillo 1978). By the end of the century, the Spanish authorities in Mexico hoped to secure the California coast and find ports and expand its thriving Pacific trade. Manila galleons, heavy sailing ships with many decks for cargo, brought silks, jewels, spices, and fine china to western Mexico from the Philippines, returning with cargoes of gold and silver from the mines of New Spain. Cabrillo explored the coast along present day San Diego, Catalina Island, San Pedro, and the Channel Islands area (Castillo 1978).

Sir Francis Drake, a British explorer, landed on the California coast in 1579. He explored the present-day Bodega Bay or Drake's Bay area, and claimed it as Britain's territory (Castillo 1978). Two hundred years later, Captain James Cook explored and mapped the coast of California and Alaska all the way to the Bering Strait.

The Russians are not known to have entered California in the sixteenth century, but beginning in 1742 they began exploring the Aleutian Islands and the west coast of Alaska seeking furs. They established a permanent settlement on Kodiak Island in 1784. Soon thereafter, native Alaskan hunters working for the Russians traveled south to hunt sea otters along the coast of California.

The Spanish were eager to establish a settlement in California because of the fear that British and Russian would continue to expand control and begin to settle along the California coast (Castillo 1978). In 1769, the Spanish organized an expedition led by Captain Gaspar de Portola and Father Junipero Serra. The expedition also resulted in the establishment of the first of twenty-one missions along the California coast, in San Diego, named San Diego de Alcala (Castillo 1978; Library of Congress 2006). The missions functioned both as economic and religious outposts of the Spanish empire.

The expedition to California also resulted in the founding of the first presidios, and by 1800 there were three presidios established along the coast. Presidios were military forts the Spanish used to obtain control of an area and to defend coastal harbors against attack. During the next fifty years, the Spanish continued to explore the coast of California, establishing missions, presidios and pueblos (civilian towns) from San Diego to Sonoma (Neusius and Gross 2007).

Western Expansion

Mexico including California became independent from Spain in 1821. This led to the secularization of missions and the removal of Native Americans from missions (Castillo 1978). Independence meant a shift of power from church to private landowners. Governors of Mexico were able to secure land grants in the form of ranchos, large pieces of lands, to individuals. The ranchos often contained buildings made from adobe, including large residences. During the Mexican period, cattle-raising, and the marketing of beef and hides became an economic staple in California (Library of Congress 2006). Fur traders and trappers settled in California during this period, and many visitors came through California on their way to Oregon.

The Mexican American War was won by the US in January, 1847, ending the Mexican Period. The population of California at that time was 150,000 Native Americans and 14,000 Mexican and European descendants (Library of Congress 2006). This was soon followed by the discovery of gold in the Sierra Nevada Mountains. The discovery of gold meant new settlers to the region, many of whom did not respect the property rights of rancho owners and squatted on their lands.

Chinese were among the largest emigrants to California during the gold rush. They were not welcome by the Anglo-miners, and the Chinese often set up camps and small enclaves which were entirely populated by Chinese (California Historical Society 2000).

California was admitted to the union as a free state in late 1850. The population and economy of the state grew rapidly in the 19th and 20th centuries. Agriculture became an important part of the economy and other industries developed, such as the oil and entertainment industries (California Historical Society 2006).

Major Industries

Mining. The discovery of gold in 1848 in Coloma, California marked a huge transition. Thousands of miners and gold-seekers came from other parts of the United States and other countries and continents. Many who came traveled by routes through seas and came through the port of San Francisco (California Historical Society 2000). Mining became a thriving industry during the 1880s, and technical advances in mining equipment, such as hydraulic mining, became a thriving industry (Library of Congress 2006).

Settlers who came to California for the gold rush found business and farming lucrative and settled in the region. Ports, such as San Francisco (then Yerba Buena) experienced growth in exports and businesses catering to the mining community thrived during the 1880s into the early 1900s. Other mining towns, called "boomtowns" were established during this period, to service the miners who traveled distances to work in the mine fields. The biggest boomtowns in near the gold fields were Sacramento and Stockton.

Agriculture, Ranching

Commercial agriculture and ranching in California had its roots in the missions and pueblos. The Spanish introduced a wide variety of Old World and Asian cereal and fruit crops and domesticated livestock to California. They also brought in irrigation systems, metal tools and crop processing methods. The missions were not only expected to be self sustaining, but they also needed to support the Presidios and provide goods to be traded. Livestock was raised for meat, but also for wool, leather, and tallow, and for cultivating the land.

After secularization there was a decline in agricultural production. With the discovery of gold, the needs of the miners and the growing cities caused a rapid increase in both crops and ranching. . Wheat became a strong agricultural product in California by 1850 (Library of Congress 2006) and cattle ranching peaked in the 1860s. Direct access to the eastern markets through the railroad in 1869 and later through refrigerated train cars allowed expansion of agriculture through the 19th century. A later transformation was the change from dryland agriculture to intensive-irrigated agriculture at the turn of the last century. California has historically produced a variety of crops including vegetables, fruit, nuts, diary, livestock, poultry, and flowers for export to other regions in the U.S. as well as to other countries. While much of the current agricultural activity is located inland, there is crop production along the coastal valleys of northern and southern California (Johnston 1994). Field crops continue to be the mainstay of the agricultural economy of California.

Railroads. Shortly after California became a state in 1850, rail lines were constructed. In 1862, President Lincoln signed the Pacific Railroad Act, which allowed construction of a railroad line from Sacramento east, built by Central Pacific Railroad and from Omaha West along the Missouri River, built by Union Pacific Railroad. The rail lines met in Promontory, Utah in 1869, completing the first Pacific Railroad (California State Railroad Museum Foundation 2001; Library of Congress 2006). The completion of the railroad meant that agricultural produce, lumber, and gold could be shipped to eastern parts of the US, while settlers were able to emigrate from the east to live in the west. . The railroad had a large impact on California immigration, which continued through the 20th century.

Trails

Juan Bautista de Anza. This trail was used by a party of 300 Spanish colonists, led by Colonel San Juan Bautista, from Mexico to California in 1775. The party intended to establish a mission and presidio in present-day San Francisco in order to secure the area from Russians and British. The party contained thirty families, a dozen soldiers, cattle, mules, and horses. It took three months to follow the trail through the southwest desert before reaching the California Coast. The trail is over 1,200 miles long. It took another three months to travel from the southern coast up to the northern coast to present-day San Francisco (USDA Forest Service 2007). This was the first overland route established to connect New Spain with San Francisco (National Park Service 2007).

Old Spanish Trail. This trail was first established by a Mexican trader, Antonio Armijo, in 1829. He traveled from New Mexico to Los Angeles on a commercial caravan, carrying Mexican woolen goods and planning to bring horses back from California (National Park Service 2007). Prior to the Old Spanish Trail, an overland southern route to California from New Mexico did not exist. The route was used often by traders and also traded with Native Americans along the route. This combination of footpaths of Native Americans, early trade explorations, and horse and mule routes make up the Old Spanish Trail. The trail was 1,200 miles long and extends from two trailheads. The trail ran through present-day Colorado, Utah, Arizona, Nevada, and California (Cultures and Histories of the American Southwest 2007).

California Trail. The trail was used by over 250,000 farmers and gold miners from Missouri during the 1840 and 1850s. The route starts along the Missouri River, and then converges on the Great Platte River Road, overlaps with the Oregon Trail and to the Rocky Mountains. After the crossing the Rockies, many routes were used to get to and cross the Sierra Nevada Mountains. The total system of trails that make-up the California Trail is approximately 5,664 miles (National Park Service 2007).

Pony Express National Historic Trail. This trail began in 1860 as a mail route connecting the eastern US with California. It was privately financed and was used only for eighteen months before the telegraph system was constructed and replaced the Pony Express. Riders on horseback transported mail from Missouri to California in ten days, traveling over 1,800 miles. The transcontinental railroad later followed much of this route (National Park Service 2007).

SOUTHWEST

The Southwest culture region covers all of Arizona, the western majority of New Mexico, the southern tip of Nevada, southern Utah, extreme southern and western Texas, and parts of southwest Colorado (Figure 3-21). Important Ancestral Puebloan occupations in Southwestern Colorado are found outside of the tribal ranges depicted at the time of contact for the Southwest region. The region does include parts of northern Mexico, but since this part of the region is not included in the project area, it is not discussed here. This is a highly varied region culturally that is rich in cultural resources and it should be noted that many of the tribes and pueblos within the cultural region may have more in common with neighboring cultural regions because of their shared environmental contexts. As a whole though, the Southwest culture region is demanding of its inhabitants and requires extensive adaptations to its environments for survival. This is recognized in the development of agriculture, domestication, stone and masonry architecture, and irrigation systems as well as the mysterious abandonments in some areas. A wide array of other traditions, some having been adopted from Mesoamerican cultures, also characterizes the cultures of the region. However, because of the diversity of the environments these adaptations vary among the subregions of the area (Neusius and Gross 2007; Ortiz 1979a; Woodbury 1979).

USFS regions included in the Southwest region include portions of Regions 2 and 4 and all of Region 3. BLM Field Offices in the region include all or portions of all field offices in New Mexico and Nevada with the exception if the Arizona Strip Office. In addition the cultural region covers a portion of the Royal Gorge Field office. In addition, the southwestern cultural region includes portions of field offices in southern Colorado.

Table I-6 identifies the Southwest culture region languages and tribes that have been documented within the project area. Culturally, the Southwest culture region is bordered by the California to the west, Great Basin to the west and north, Plains to the north and east, and Southeast to the east.

Table I-6
Languages and Tribes of the Southwest Culture Region in the Project Area

Language (Linguistic Phylum)	Tribes
Yuman (Hokan)	Walapai, Havasupai, Yavapai, Mohave, Halchidhoma, Quechan, Cocopa, Maricopa
Uto-Aztecan (Aztec-Tanoan)	Papago and Upper Pima, Hopi, Jocome and Jano, Tewa, North Tiwa, South Tiwa, Jemez, Pecos, Tano
Athapascan (Na-Dene)	Navajo, Western Apache, Chiricahua Apache, Mescalero Apache, Jicarilla Apache
Zunian (Penutian)	Zuni
Keresan (Undetermined linguistic phylum)	Rio Grande Keresans, Acoma, Laguna
Kiowa-Tanoan (Aztec-Tanoan)	Piro, Tompiro

Source: Ortiz 1979b; Neusius & Gross 2007; Waldman 2000

No single framework of Southwest cultural chronology is entirely appropriate for the whole culture region given the high degree of variability across it. However, there is enough similarity in the development of the major characteristics of the culture region for researchers to have established a very general chronology while limiting the amount of subareas discussed for each period (Neusius and Gross 2007; Ortiz 1979a; Woodbury 1979). Throughout the region the evidence for a Pre-Clovis occupation is rare, but there is definite evidence of a Clovis and post-Clovis Paloeindian occupation. The following outlines the general chronology of the Southwest culture region. Unlike other regions, the more recent cultural and technological patterns of the Southwest do not allow for an overall chronology after the Archaic Period and more localized patterns must be used (Neusius and Gross 2007).

- Paleoindian: pre-8000 BP
- Archaic: 8000 – 1750 BP
- Early Archaic: 8000 – 3500 BP
- Late Archaic: 3500 – 1750 BP
- Fully Developed Regional Traditions: 1750 – 400 BP

The Historic period then follows the localized regional traditions in the Southwest.

CULTURAL HISTORY

Prehistoric

Paleoindian: Southwest populations of the Paleoindian Period were organized into small, mobile groups of hunter-gatherers and resembled the Great Plains in many ways (Irwin-Williams 1979; Neusius and Gross 2007). Evidence for Pre-Clovis (pre-11,500 BP) people in the region is scant and what does exist is not very reliable. Evidence for Clovis hunters is much more accepted and found across the Southwest culture region, if not still in small numbers. In fact, Clovis points are named after the town in New Mexico, where examples were found in 1929. Such evidence comes from mammoth and bison kill and butchering sites where bones of the large game are associated with Clovis points as well as surface finds of Clovis points throughout the Southwest culture region (Neusius and Gross 2007). Paleoindian lifeways in general in the Southwest were intimately tied to the changing environmental and climatic context, technological innovations and adaptions, changing population sizes, and changing social organization (Irwin-Williams 1979; Neusius and Gross 2007).

Following the early Paleoindian Period, distinct patterns developed in the east and west portions of the Southwest, marked by the Arizona and New Mexico state line. In the east, a definite Folsom lithic technology with large game hunting is seen beginning around 11,000 BP. In the western Southwest, post-Clovis evidence is rare and what evidence has been found does not seem to indicate a reliance on big game hunting. This pattern continued throughout the rest of the Paleoindian Period, however late Paleoindian sites of the eastern Southwest, which tend to be situated in the foothill and mountain areas, appear to lack the diagnostic Folsom points (Neusius and Gross 2007).

Archaic: Unlike other culture regions, there is less distinction between the subperiods of the Archaic in the Southwest culture region (Neusius and Gross 2007). Additionally, Paleoindian similarities between the region and the Great

Plains disappear (Irwin-Williams 1979). As a whole however, sites of this age are typically ephemeral because they were used for comparatively short periods of time, although simple houses first occur in the region during the first half of this period. The Archaic Period brings the first indication of regional variation among groups in the Southwest culture region (Neusius and Gross 2007).

The Early Archaic corresponds with a climatic interval called the Altithermal when moisture levels varied locally and temperatures were unusually warm. Pleistocene large game disappeared presumably due to this environmental shift. These factors combined to require new adaptations by Southwest culture region populations. The largest difference is in technology. Groundstone occurs much more frequently in sites, including millingstones which indicate an increased reliance on seeds in the diet. Projectile points become smaller and their form changed from Folsom-type fluted and stemmed points to side- and corner-notched points with new hafting techniques. A variety of other stone tools are also included in the Archaic toolkit. The foragers of this time likely followed blooming and ripe plants. In the southern portion of the Southwest, this likely drew people to the valleys of permanent rivers. Caves and rockshelters of these kinds of areas were frequently used (Neusius and Gross 2007).

Four Archaic regional variants developed during the Early and continued into the Late Archaic Periods, incorporating the above adaptations as necessary: San Dieguito-Pinto in the west, Oshara in the north, Cochise in the southwest, and Chihuahua in the southeast. Pinto sites are often found as surface sites in dry lake basins and along drainages. Oshara sites develop into seasonal fall or winter camps. The Cochise concept is under debate, but later sites attributed to it tend to include simple houses. Chihuahua sites are similar to Oshara and Pinto sites, but are not well understood incorporating their own distinct artifacts and patterns. Although each of these areas and traditions have their own expressions, the Late Archaic Southwest populations practiced a broad-spectrum subsistence method, based on hunting large game and supported by trapping small game and gathering and storing seeds (Irwin-Williams 1979; Neusius and Gross 2007).

The Late Archaic saw the onset of modern, moister conditions. This change once again demanded additional adaptations by populations in the above traditions, most notably with the planting of crops. The skill of plant cultivation spread to the Southwest culture region from Mesoamerica (Woodbury and Zubrow 1979; Neusius and Gross 2007). It should be noted that not all cultigens of Mesoamerica transferred to North America. Crops grown in the Southwest included maize, cotton, squash, and the common bean and bottle gourd. Foragers of the Southwest did not immediately give up their mobile lifeways following the adoption of crop planting. Early crops were likely "casual" with people providing minimal tending so a lost crop would not have represented a total loss of effort (Neusius and Gross 2007). However, sedentism eventually did take place and populations increased (Irwin-Williams 1979; Neusius and Gross 2007). This was likely due to a symbiotic relationship between agriculture and population size. The better people got at agriculture, the larger the population grew. Increased populations become more dependent upon agriculture since the naturally occurring resources cannot support the higher numbers manipulated plants can. The increased dependence of a population on crops would have required people to restrict their mobility in order to consistently tend to the crops and ensure their productivity. The extreme investment made in crop productivity and populations' dependence on crops is evident in the irrigation systems developed at some sites of the Late Archaic (Neusius and Gross 2007).

Regional Traditions: Beginning and continuing on since the Archaic agriculture became widespread throughout the Southwest culture region. Subsistence became dependent upon crops, especially maize, beans, and squash. Other crops were eventually grown in the more southern areas of the Southwest where extensive irrigation systems of canals and wells were dug (Woodbury and Zubrow 1979; Neusius and Gross 2007). This is not to say that agriculture was the only means of subsistence. Hunting and seed collecting continued to play a part in obtaining food. Additionally turkeys and dogs began to be domesticated. As all of these resources became increasingly more reliable for groups, people became more sedentary and healthy. More productive areas attracted more people. So settlements in the Southwest culture region began to grow through increased births and in-migration. Architecture began to become elaborated with development of pueblos and features that were conducive to community integration, such as the multi-family pueblo dwellings (Neusius and Gross 2007).

Although these general patterns were experienced across the culture region the varying environmental conditions across the region demanded some different adaptations for survival. The settled village dwellers of the Southwest culture region are generally divided into five groups based on their unique regional traditions: the Anasazi in the Plateau country of the northern Southwest culture region, the Hohokam in the low deserts of Arizona, the Mogollan in the area from southern New Mexico west to Arizona's Verde River and south in northern Mexico, the Patayan in the Colorado River Valley and adjacent lands, and the Sinagua in the area from Flagstaff to Phoenix in Arizona. The Anasazi culture is recognized by its coil-and-scrape red and white ceramic pottery with black paint, the early construction of pithouses and masonry surface rooms that later developed into large pueblos, kivas, and cliff dwellings, likely due to population aggregation and political and social integration, and the practice of dry farming although some simple irrigation canals were developed later. The Anasazi subregion was abandoned sometime between 950 and 850 BP, likely due to environmental conditions, but was re-populated again later. The Hohokam culture is recognized by its paddle-and-anvil red or buff pottery with red paint, irrigated farming along rivers as well as flood farming in arroyo mouths, and clusters of houses built in pits developing into groups of clusters with associated integrative facilities (i.e. ball courts, plazas, and platform mounds). The culture was centered on the Gila and Salt River basins near Phoenix, Arizona. The Mongollon culture is characterized by coil-and-scrape red- and brownwares early on with red- and black-on-white pots later and Mimbres pottery even later, pithouses that developed into surface pueblos, and dry farming supported with hunting. Early Mongollon sites tend to be walled, suggesting defense, and situated on hilltops and mesas. Site location then shifted to along rivers and on river terraces. The Patayan culture includes paddle-and-anvil pottery with buffware in the lowlands of the subregion and brown pottery in the uplands, dry masonry rock features, including walls and earth ovens, and flood agriculture along the Colorado River and rainfall farming elsewhere in the subregion supported with hunting and gathering. Settlements during the growing season were situated along rivers, where flooding and modern development have had destructive effects, and in the uplands at other times where pit and surface structures were constructed as well as making use of rockshelters. The Sinagua culture is the most poorly known of these groups. What is known is that the culture is characterized by farming, pueblo-style communities, and paddle-and-anvil red- and brownware pottery tempered with cinders or crushed volcanic rock. Many settlements have been buried by volcanic eruptions that began in 866 BP, the ash of which may have made the soils of the region more productive for agriculture attracting more people, but the northern part of the subregion was eventually abandoned around 650 BP (Neusius and Gross 2007).

As noted above, a number of abandonments occurred throughout the Southwest culture region, including Virgin Anasazi area of southeast Arizona, the Kayenta Anasazi of northern Arizona, the Mesa Verde region of southwest Colorado, most of the Sinagua region, and some parts of the Mogollan area highlands. Groups appear to have relocated and aggregated into large settlements in several localities, making them more sensitive for cultural resources of this time period. Such areas include the Rio Grande valley, west central and eastern New Mexico, and eastern Arizona. It is believed that a drought in the northern parts of the Southwest culture region, which was abandoned by 650 BP, caused these population movements. Other theories involve warfare and violence forced the movements and cooperation between some groups. However, a clear line of descendency between prehistoric populations and modern Native American populations in the Southwest culture region is apparent in the continuity of lifeways (Neusius and Gross 2007).

Historic

Spanish explorers in the Southwest were the first to have contact with the Native Americans of the culture region (Neusius and Gross 2007; Ortiz 1979a). As Spanish towns, presidios, and missions were established contact increased, particularly at missions where the intent was to introduce Christianity to native populations and were thus built near existing population centers. Although some populations rejected Christianity and Spanish governmental institutions, they still adopted some useful items including metal plows and hoes and expanded their crops to include items like apples, peaches, and apricots. As in other areas, Native Americans participated in trade relations with the Spanish and other Europeans. Some Spanish pueblos traded with tribes of other regions, such as the Plains. Of course relations were not always so mutually beneficial though and in fact some tribes were often the adversaries of US soldiers later in time as the US continued to expand and explore westward (Neusius and Gross 2007).

Euro American Contact

The Spanish explored the region beginning in 1540s by following the Rio Grande north from Mexico. Vasquez de Coronado and his men traveled through much of the southwestern United States, ventured deep into the plains of Kansas, descended the walls of the Grand Canyon, and visited all the major Indian villages in the region. Although the gold Coronado was seeking was not found, the Spanish started settling the area soon thereafter and established a colony with the capital at Santa Fe (Neusius 2007). Other cities and towns were established primarily in river valleys and associated with existing Native American communities. Missions, military outposts and towns were founded, primarily in New Mexico, but also in Arizona and Texas to convert natives, protect settlers and solidify colonial rule. Santa Fe was founded in 1610, Albuquerque in 1706, Las Trampas in 1751, and Taos between 1780 and 1800 (Neusius 2007; National Park Service 2007). In Northern New Mexico, the Pueblo people revolted and drove out the Spanish in 1680, but the Spanish were able to return by 1692. In Arizona, Father Eusebio Kino, a Jesuit, founded the missions of Guevavi (1692) and Tumacacori (1696), near Nogales, and San Xavier del Bac (1700), near Tucson. The Spanish Empire, however, expelled the Jesuits in 1767, and those in Arizona subsequently lost their control over the indigenous people.

Mexico obtained control over the Southwest region in 1821 following the Mexican war of independence from Spain. With independence came commercial freedom and expansion of trade between Mexico and the United States. The U.S. gained control over the region during the Mexican- American War (1846-1848). Under the Treaty of Guadalupe Hidalgo parts of Colorado, Arizona, New Mexico, and Wyoming, as well as the whole of California, Nevada, and Utah were ceded to the U.S. The remaining parts of what are today the states of Arizona and New Mexico were later ceded under the 1853 Gadsden Purchase. Although military posts, stage routes, ranches, mines and American settlements were established, the region retained many of the well-established Spanish and Mexican traditions (Reeves 1905).

Trade

Missions. The Spanish colonial system was based on rights that the Pope had reserved to the monarchy which granted them newly discovered lands in the New World on the condition that they evangelize the native inhabitants. The missions of New Spain were economic outposts in addition to opportunities to save souls. The Spanish introduced new crops, animals, industries and forms of agriculture from Europe, but also established a trusteeship labor system over the indigenous people they conquered. They had the authority to tax the people under their care and to require them to perform labor. In return, the Spanish were expected to maintain order and to provide teachings in Catholicism. Because in practice there was little respect for native populations and their traditions, they were exploited. Many of the original missions were destroyed in the Pueblo Revolt. When the Spanish returned, the economic importance of the missions waned and trade and commerce in the towns became less dependent on native labor.

Mining. Turquoise had been mined in the Ortiz Mountains south of Santa Fe and traded throughout the Southwest and Mexico long before the Spanish arrived. Other minerals were mined for use in pottery production. The search for mineral wealth was a major reason for the initial interest in the Southwest by the Spanish. Silver was discovered in the 1730s, and was much more abundant than gold (Statistical Research, Inc. 2000). After the Mexican-American War and the Gadsden Purchase, the population of the southwest grew as miners from America rushed in. Mining districts were abundant by the 1860s (Statistical Research, Inc. 2000). Gold was found in the Ortiz Mountains in 1828 (New Mexico Economic Development 2007). Copper was also a prominent mineral in southern New Mexico and Arizona, especially after the decline of the silver market in the late 1880s. Mining was originally done by placer and vein mining, but changed to open pit mining after World War II (Statistical Research, Inc. 2000). The copper industry continues to be a force in the economy. After World War II uranium became an important mineral resource in the Navajo Nation in northern Arizona and New Mexico, as did coal. Towns, made up of commercial centers, saloons, and hotels, were established in close proximity to mines in order support the miners. Many of these towns followed a boom/bust cycle and were abandoned when the mines were depleted.

Ranching. Ranching continues to be important part of the Southwest region's economy. The Spanish brought sheep, goats, cattle and horses, which became the mainstay of livestock raised in the area. Spanish land grants and Indian lands were often broken up or acquired through legal maneuvering. The Homestead Act of 1862 and the Desert Land Act of 1877 further encouraged and promoted the economic development of the arid and semiarid public lands of the Southwest. These laws opened inexpensive land to farmers and attracted settlers. The construction of rail lines was responsible for the growth of cattle ranching, because cattle could be transported via rail to markets in the eastern portions of the US. (New Mexico Economic Development 2007). Homesteading continued into the twentieth century through the end of World War I.

Western Expansion

New Mexico was recognized as a territory of the United States in 1850, Nevada became a territory in 1861, and Arizona Territory was formed in 1864. The Gadsden Purchase of 1854 added roughly 30,000 square miles of to the New Mexico Territory. More ranches and farms were established during this period, and mining was a booming part of the economy. Several towns and cities sprang up around the mines and were later abandoned as the mining industry waned and mineral deposits were depleted (Neusius 2007).

Trails

Juan Bautista de Anza. This trail was used by a party of 300 Spanish colonists, led by Colonel San Juan Bautista, from Mexico to California in 1775. The party intended to establish a mission and presidio in present-day San Francisco in order to secure the area from Russians and British colonization. The party contained thirty families, a dozen soldiers, cattle, mules, and horses. It took three months to follow the trail through the southwest desert before reaching the coast of California. It took another three months to travel from the southern coast up to the northern coast to present-day San Francisco. The trail is over 1,200 miles long (USDA Forest Service 2007). This was the first overland route established to connect New Spain with San Francisco (National Park Service 2007).

El Camino Real de Tierra Adentro. This trail dates dating back to the Spanish Colonial era during the 16th to 19th centuries, when it was the primary route between Mexico City, the Spanish capital, and other Spanish provincial towns (Bureau of Land Management 2008). From Mexico, the trail crosses briefly into West Texas at El Paso and north through New Mexico, primarily in the Rio Grande corridor to Santa Fe. The trail was also used for trade and interaction between Europeans, Spaniards, Mexicans, and Native Americans and affected settlement and development within the southwest (National Park Service 2006).

Old Spanish. This trail was first established by a Mexican trader, Antonio Armijo, in 1829. He traveled from New Mexico to Los Angeles on a commercial caravan, carrying Mexican woolen goods and planning to bring horses back from California (National Park Service 2007). Prior to the Old Spanish Trail, an overland southern route to California from New Mexico did not exist. The route was used often by traders and also traded with Native Americans along the route. The trail has been used as a Native American footpath, an early trade route, and a horse and mule trail. The trail runs through present-day Colorado, Utah, Arizona, Nevada, and California (Cultures and Histories of the American Southwest 2007).

Santa Fe Trail. The Santa Fe Trail was used for trade and commerce between Missouri and Santa Fe, New Mexico from 1821 and 1880 (National Park Service 2008). Near Cimarron, Kansas the Trail branches into two routes: the

Mountain Route through Colorado and the Cimarron Route through the Oklahoma panhandle to New Mexico (Santa Fe 2008). Except for a short hiatus during the Mexican-American War between 1846 and 1848, the trail provided international passage of goods and travelers. The trail was important in changing over time the culture of the Southwest from the Spanish and Mexican to American. Both during and after the war, the Santa Fe Trail was used heavily for freighting of military supplies to forts in the southwest. Once the railroad extended into the southwest territory, the trail was no longer used.

Railroads. Mineral wealth in the area attracted Americans living in the east to the southwest region and an efficient mode of transportation was needed (US Department of State 2007). The Gadsden Purchase allowed the development of a southern route across the continent. The Atchison, Topeka, and Santa Fe rail lines were constructed in New Mexico by the late 1800s. The Southern Pacific Railroad went through Arizona from the west and into New Mexico. There, it met the Atchison, Topeka, and Santa Fe rail lines in Deming in 1881 (New Mexico Economic Development 2007). The development of this railroad network served the primary purpose of exporting mineral resources out of the southwest. However, as the Southern Pacific Railroad developed westward, and the Atchison, Topeka, and Santa Fe lines linking it to the north, Albuquerque quickly became an important hub of commerce and travel. The Southern Pacific line provided a link to the east coast, which fostered the "Americanization" of the southwestern states, bringing settlers, goods, industry, and missionaries. The Atchison, Topeka, and Santa Fe lines provided a north-south movement of the same. Albuquerque was advertised as a premiere destination for emigrants traveling from the east (Dreesen 1980).

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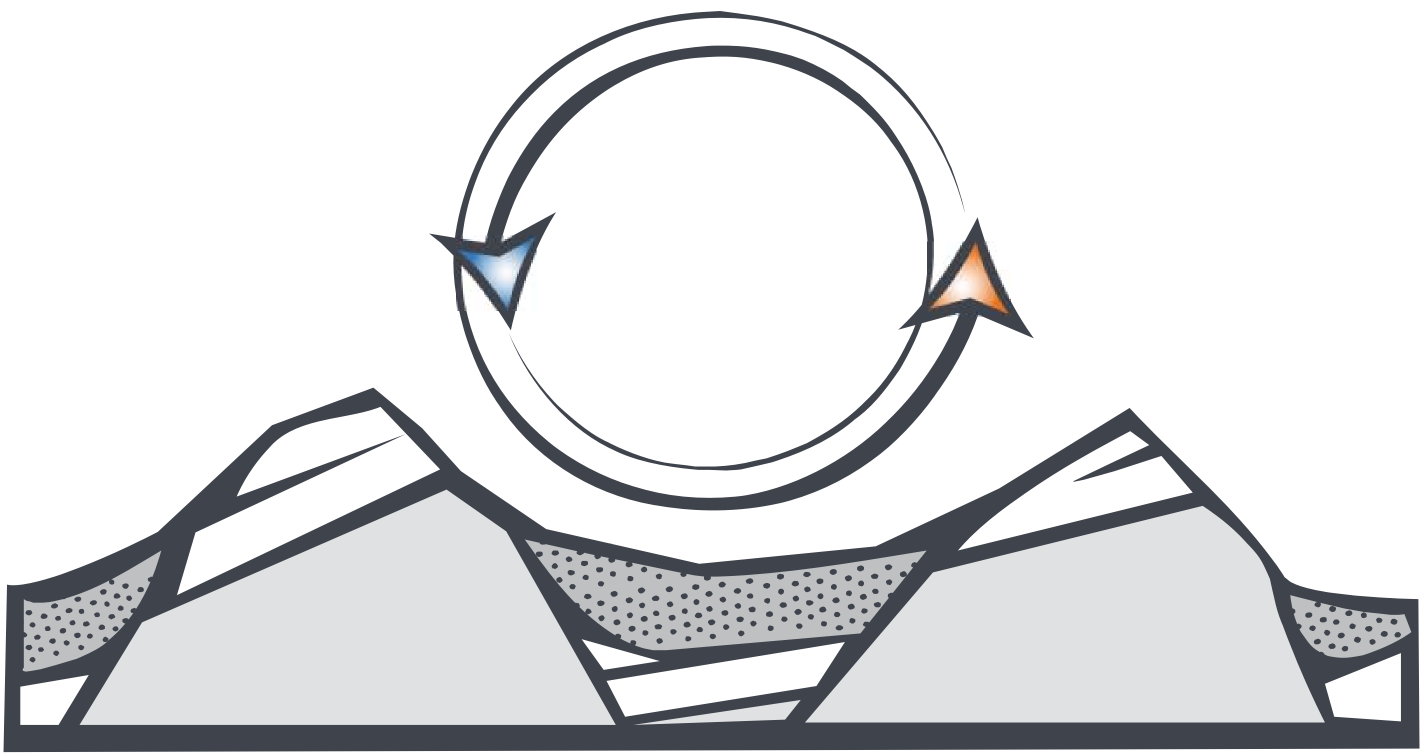

Appendix J

Special Designation Areas on BLM and FS Lands in the 12 Western States

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APPENDIX J
SPECIAL DESIGNATION AREAS ON BLM AND FS LANDS WITHIN THE PROJECT AREA

The following tables list acreage of congressional and administrative designations within the project area by government agency, type of special designation and state or national forest. Because the same area of land can be assigned multiple designations, total acreage of specially designated land within the project area is not calculated here, as combining totals would include acreage overlap.

Table J-1 lists acreage on BLM lands by state and type of designation.

Table J-2 lists acreage on FS lands by national forest and type of designation. Categorization by state was not possible as many national forests cross state lines.

Table J-1
Special Designation Areas on BLM Public Lands within the Project Area

State	Acreage					
	Congressional Designations				Administrative Designations	
	Wilderness Areas	National Conservation Areas	Wild and Scenic Rivers	National Monuments	Wilderness Study Areas	Areas of Critical Environmental Concern (BLM)[1]
Alaska	0	2,012,082	297,656	0	87,060	2,926,672
Arizona	1,385,882	119,123	0	1,742,579	63,990	676,749
California	3,656,240	10,792,788	39,000	296,951	1,035,027	1,304,474
Colorado	139,529	173,075	178	162,785	619,442	358,146
Idaho	693	484,638	56	272,640	1,333,574	656,171
Montana	6,126	0	33,897	367,507	412,481	2,906,653
Nevada	1,998,197	1,053,119	0	6,548	2,546,992	198,347
New Mexico	151,137	228,591	22,897	4,108	960,463	468,488
Oregon/Washington	193,306	422,907	237,921	52,843	2,737,779	825,622
Utah	132,162	5,081	0	1,864,264	3,273,285	1,212,014
Wyoming	0	0	0	0	571,501	917,212
Total	**7,663,272**	**15,291,405**	**631,605**	**4,770,225**	**13,641,594**	**12,450,547**

[1] Areas of Critical Environmental Concern are a BLM-specific designation

Source: BLM 2008

Table J-2
Special Designation Areas on NFS Lands within the Project Area

Forest	Acreage: Congressional Designations: Wilderness Areas	National Scenic Areas	National Recreation Areas	Wild and Scenic Rivers	Other Congressionally Designated Areas (FS)[1]	National Monuments	Administrative Designations: Wilderness Study Areas	National Roadless Areas (FS)[2]
Angeles National Forest	81,907				14,168			200,290
Apache-Sitgreaves National Forests	22,214							337,219
Arapaho and Roosevelt National Forests	305,779		35,623	20,528	10,659			393,401
Ashley National Forest	271,540		200,115					795,625
Beaverhead-Deerlodge National Forest	219,161						154,988	1,830,896
Bighorn National Forest	191,921							620,561
Bitterroot National Forest	754,257						101,694	405,883
Black Hills National Forest								9,259
Boise National Forest	64,945							1,109,148
Bridger-Teton National Forest	1,297,005						109,352	1,430,637
Caribou-Targhee National Forest	134,606							1,587,205
Carson National Forest	84,391			1,997			43,739	161,071
Chugach National Forest							1,969,892	1,972,397

Table J-2
Special Designation Areas on NFS Lands within the Project Area

Forest	Acreage: Congressional Designations: Wilderness Areas	National Scenic Areas	National Recreation Areas	Wild and Scenic Rivers	Other Congressionally Designated Areas (FS)[1]	National Monuments	Administrative Designations: Wilderness Study Areas	National Roadless Areas (FS)[2]
Cibola National Forest	137,628				49,927			246,220
Clearwater National Forest	261,923			23,802	16,481			988,597
Cleveland National Forest	75,580							130,755
Coconino National Forest	179,346			2,918				52,705
Colville National Forest	31,451							181,693
Comanche National Grassland	337,256						61,341	679,997
Coronado National Forest	331,728						143,995	144,947
Custer National Forest	182,716			27,067	42,950			136,467
Deschutes National Forest	82,836					55,500		851,970
Dixie National Forest	101,751							101,056
Eldorado National Forest								716,903
Fishlake National Forest	1,076,152		15,274	23,594				478,673
Flathead National Forest	115,536			11,904				118,718
Fremont-Winema National Forests	717,860				35,050		143,995	703,843

Table J-2
Special Designation Areas on NFS Lands within the Project Area

Forest	Acreage: Congressional Designations: Wilderness Areas	National Scenic Areas	National Recreation Areas	Wild and Scenic Rivers	Other Congressionally Designated Areas (FS)[1]	National Monuments	Administrative Designations: Wilderness Study Areas	National Roadless Areas (FS)[2]
Gallatin National Forest	179,127	33,077						212,623
Gifford Pinchot National Forest	261,923			23,802	16,481			988,597
Gila National Forest	791,784						59,869	749,056
Grand Mesa, Uncompahgre and Gunnison National Forests	551,800		50,969		27,754			1,203,841
Helena National Forest	112,241							444,809
Humboldt-Toiyabe National Forest	913,911		275,634				178,756	3,383,841
Idaho Panhandle National Forest	10,387			23,288			6,014	828,950
Inyo National Forest	639,253	119,238		2,259				966,391
Kaibab National Forest	108,831							53,055
Klamath National Forest	372,503			44,118	18,196			454,277
Kootenai National Forest	93,765	4,808					34,605	638,266
Lassen National Forest	78,109				16,351			186,846
Lewis and Clark National Forest	365,570						169,143	1,003,874
Lincoln National Forest	82,097						20,929	213,182

Table J-2
Special Designation Areas on NFS Lands within the Project Area

Forest	Acreage							
	Congressional Designations						Administrative Designations	
	Wilderness Areas	National Scenic Areas	National Recreation Areas	Wild and Scenic Rivers	Other Congressionally Designated Areas (FS)[1]	National Monuments	Wilderness Study Areas	National Roadless Areas (FS)[2]
Lolo National Forest	147,965		25,463					758,439
Los Padres National Forest	807,856			1,378				1,037,208
Malheur National Forest	78,353			10,801				181,508
Manti-Lasal National Forest	46,358							645,971
Medicine Bow-Routt National Forest	329,668							821,679
Mendocino National Forest	136,211			4,550				214,202
Modoc National Forest	63,937							202,416
Mt Baker-Snoqualmie National Forest	703,934		8,675	18,780	143,121			415,304
Mt. Hood National Forest	187,268	42,582		51,334	82,328			118,026
Nez Perce National Forest	869,442			10,532				502,240
Ochoco National Forest	35,201			7,575	83,910			61,010
Okanogan National Forest	627,335							427,097
Okanogan-Wenatchee National Forests	844,055				87,862		15,980	579,183

Table J-2
Special Designation Areas on NFS Lands within the Project Area

Acreage

Forest	Congressional Designations						Administrative Designations	
	Wilderness Areas	National Scenic Areas	National Recreation Areas	Wild and Scenic Rivers	Other Congressionally Designated Areas (FS)[1]	National Monuments	Wilderness Study Areas	National Roadless Areas (FS)[2]
Olympic National Forest	87,577				312,297			85,607
Payette National Forest	780,261			465				904,516
Pike-San Isabel National Forest	425,845							688,086
Plumas National Forest	23,697			18,794	18,423			85,986
Prescott National Forest	101,515			1,511				165,490
Rio Grande National Forest	430,175				1,410			669,024
Rogue River-Siskiyou National Forests	299,684			70,754				368,716
Salmon-Challis National Forest	1,209,082		28					2,264,053
San Bernardino National Forest	130,535							223,329
San Juan National Forest	423,907				62,356			696,594
Santa Fe National Forest	283,541		44,680	51,757				375,008
Sawtooth National Forest	217,737		566,485					1,227,815
Sequoia National Forest	293,786			9,282		286,505		467,232
Shasta-Trinity National Forest	495,678		167,900	20,178	13,112			500,142

Table J-2
Special Designation Areas on NFS Lands within the Project Area

Forest	Acreage: Congressional Designations: Wilderness Areas	National Scenic Areas	National Recreation Areas	Wild and Scenic Rivers	Other Congressionally Designated Areas (FS)[1]	National Monuments	Administrative Designations: Wilderness Study Areas	National Roadless Areas (FS)[2]
Shoshone National Forest	1,366,372			6,369	30,050		13,526	686,864
Sierra National Forest	566,927			9,738	33,028	24,279		417,354
Siskiyou National Forest	22,230							51,911
Siuslaw National Forest	121,162		204,668	63,122	7,756			314,659
Six Rivers National Forest	215,413		30,637	9,662	1,662			232,480
Stanislaus National Forest	49,184			7,521	2,895			219,399
Tahoe National Forest	430,175				1,410			669,024
Tongass National Forest	5,745,617		7,009		853,882			6,486,542
Tonto National Forest	577,676			757				271,657
Uinta National Forest	58,458							527,676
Umatilla National Forest	297,685			6,636				282,220
Umpqua National Forest	71,785			6,485	37,008			109,731
Wallowa-Whitman National Forest	372,212		625,090	20,382				514,674
Wasatch-Cache National Forest	309,202							598,385

Table J-2
Special Designation Areas on NFS Lands within the Project Area

Forest	Acreage: Congressional Designations: Wilderness Areas	National Scenic Areas	National Recreation Areas	Wild and Scenic Rivers	Other Congressionally Designated Areas (FS)[1]	National Monuments	Administrative Designations: Wilderness Study Areas	National Roadless Areas (FS)[2]
White River National Forest	748,158							639,602
Willamette National Forest	391,247			14,272	18,897			170,168
Total	**32,352,798**	**199,705**	**2,258,250**	**604,110**	**2,021,534**	**366,284**	**3,227,819**	**52,934,355**

[1] "Other Congressionally Designated Area" is a FS-specific designations
[2] "National Roadless Area" is a FS-specific designation

Source: FS2008 a

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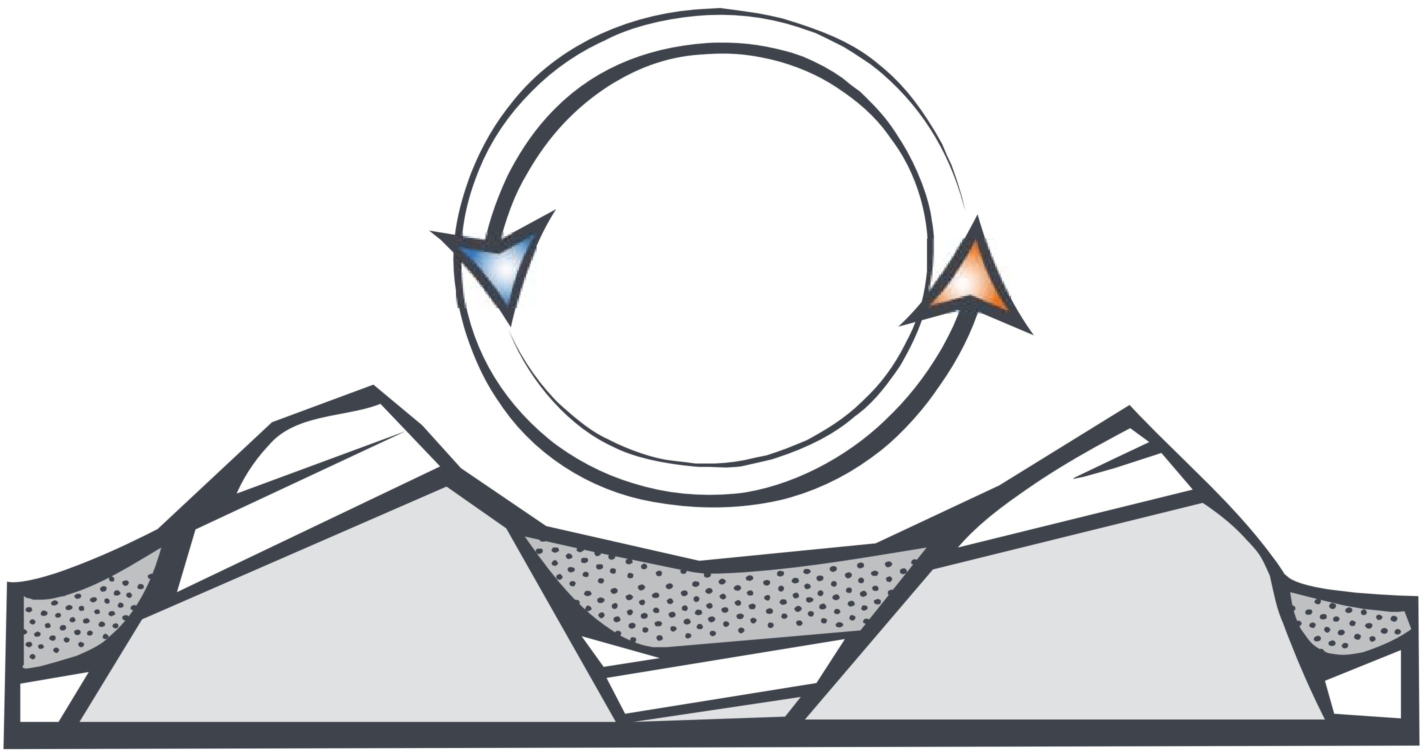

Appendix K

Special Designation Areas on BLM and FS Lands in the Potential Geothermal Area

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APPENDIX K
SPECIAL DESIGNATION AREAS ON BLM AND FS LANDS WITHIN THE PLANNING AREA

The following tables list acreage of congressional and administrative designations within the planning area by government agency, type of special designation and state or national forest. Because the same area of land can be assigned multiple designations, total acreage of specially designated land within the planning area is not calculated here, as combining totals would include acreage overlap. Total acreage of special designations within the planning area can be found in Section 2-2.

Table K-1 lists acreage on BLM lands by state and type of designation.

Table K-2 lists acreage on FS lands by national forest and type of designation. Categorization by state was not possible as many national forests cross state lines.

Table K-1
Special Designation Areas on BLM Public Lands within the Planning Area

	Acreage					
	Congressional Designations				Administrative Designations	
State	Wilderness Areas	National Conservation Areas	Wild and Scenic Rivers	National Monuments	Wilderness Study Areas	Areas of Critical Environmental Concern (BLM)
Alaska	0	935,659	85,415	0	0	1,378,832
Arizona	1,114,774	551,557	0	551,557	63,795	597,113
California	2,813,231	296,933	8,682	296,933	1,003,587	1,457,961
Colorado	69,206	104,780	178	104,780	377,655	262,551
Idaho	693	272,640	56	272,640	1,306,415	794,889
Montana	6,126	49	0	49	209,844	45,815
Nevada	1,998,197	6,548	0	6,548	2,546,992	1,282,282
New Mexico	151,137	4,108	22,897	4,108	861,796	452,988
Oregon/Washington	184,705	51,422	216,026	51,422	2,737,779	864,162
Utah	103,861	0	0	0	520,953	186,907
Wyoming	0	0	0	0	422,108	920,063
Total	**6,441,930**	**2,223,694**	**333,254**	**1,288,035**	**10,050,923**	**8,243,565**

[1] Areas of Critical Environmental Concern are a BLM-specific designation

Source: BLM 2008a

Table K-2
Special Designation Areas on FS Lands within the Planning Area

Forest	Acreage							
	Congressional Designations						Administrative Designations	
	Wilderness Areas	National Scenic Areas	National Recreation Area	Wild and Scenic Rivers	Other Congressionally Designated Areas (FS)[1]	National Monuments	Wilderness Study Areas	National Roadless Areas (FS)[2]
Angeles National Forest	76,717							200,460
Apache-Sitgreaves National Forests	81,907	0	0	0	14,168	0	0	200,290
Arapaho and Roosevelt National Forests	4,290	0	0	0	10,659	0	0	230,624
Ashley National Forest	305,769	0	35,622	20,527	0	0	0	385,305
Beaverhead-Deerlodge National Forest	0	0	102,682	0	0	0	0	29,285
Bitterroot National Forest	219,150	0	0	0	0	0	154,980	1,830,896
Boise National Forest	754,229	0	0	0	0	0	101,690	405,883
Bridger-Teton National Forest	64,942	0	0	0	0	0	0	1,109,148
Caribou-Targhee National Forest	712,267	0	0	0	0	0	109,347	758,939
Carson National Forest	134,602	0	0	0	0	0	0	1,587,205
Cibola National Forest	84,391	0	0	1,997	0	0	43,739	161,071
Clearwater National Forest	73,467	0	0	0	30,482	0	0	239,071
Cleveland National Forest	261,915	0	0	23,665	0	0	0	333,364
Coronado National Forest	75,580	0	0	0	0	0	0	130,755
Custer National Forest	29,981	0	0	0	0	0	0	47,148

Table K-2
Special Designation Areas on FS Lands within the Planning Area

Forest	Acreage							
	Congressional Designations						Administrative Designations	
	Wilderness Areas	National Scenic Areas	National Recreation Area	Wild and Scenic Rivers	Other Congressionally Designated Areas (FS)[1]	National Monuments	Wilderness Study Areas	National Roadless Areas (FS)[2]
Deschutes National Forest	182,711	0	0	27,067	42,949	55,500	0	136,467
Dixie National Forest	57,255	0	0	0	0	0	0	504,124
Fishlake National Forest	0	0	0	0	0	0	0	484,666
Fremont-Winema National Forests	115,534	0	0	11,904	0	0	0	118,718
Gallatin National Forest	651,552	0	0	0	35,048	0	143,991	544,958
Gifford Pinchot National Forest	179,126	33,077	0	0	0	0	0	212,623
Gila National Forest	791,776	0	0	0	0	0	59,869	749,056
Grand Mesa, Uncompahgre and Gunnison National Forests	551,793	0	50,967	0	27,753	0	0	1,192,054
Helena National Forest	1,176	0	0	0	0	0	0	269,501
Humboldt-Toiyabe National Forest	795,845	0	275,629	0	0	0	98,446	3,337,293
Inyo National Forest	597,938	104,641	0	2,259	0	0	0	938,360
Klamath National Forest	0	0	0	0	18,195	0	0	4,033
Lassen National Forest	43,970	0	0	0	16,350	0	0	119,188
Lewis and Clark National Forest	0	0	0	0	0	0	0	7,618
Lincoln National Forest	0	0	0	0	0	0	0	30,493

Table K-2
Special Designation Areas on FS Lands within the Planning Area

Forest	Acreage							
	Congressional Designations						Administrative Designations	
	Wilderness Areas	National Scenic Areas	National Recreation Area	Wild and Scenic Rivers	Other Congressionally Designated Areas (FS)[1]	National Monuments	Wilderness Study Areas	National Roadless Areas (FS)[2]
Lolo National Forest	38,108	0	0	0	0	0	0	127,775
Los Padres National Forest	797,759	0	0	1,374	0	0	0	1,037,208
Malheur National Forest	78,351	0	0	10,801	0	0	0	181,508
Manti-Lasal National Forest	0	0	0	0	0	0	0	76,907
Medicine Bow-Routt National Forest	250,639	0	0	0	0	0	0	505,938
Mendocino National Forest	36,294	0	0	0	0	0	0	113,800
Modoc National Forest	63,936	0	0	0	0	0	0	202,416
Mt Baker-Snoqualmie National Forest	703,906	0	8,675	18,779	143,119	0	0	415,304
Mt. Hood National Forest	187,265	42,581	0	51,333	82,326	0	0	118,026
Nez Perce National Forest	869,412	0	0	10,532	83,909	0	0	502,240
Ochoco National Forest	35,199	0	0	7,574	0	0	0	61,010
Okanogan National Forest	621,814	0	0	0	87,859	0	0	338,748
Okanogan-Wenatchee National Forests	737,119	0	0	0	144,112	0	15,194	272,402
Payette National Forest	780,233	0	0	465	0	0	0	904,516
Pike-San Isabel National Forest	425,836	0	0	0	0	0	0	688,086
Plumas National Forest	4,408	0	0	6,623	22	0	0	21,313

Table K-2
Special Designation Areas on FS Lands within the Planning Area

Forest	Acreage							
	Congressional Designations						Administrative Designations	
	Wilderness Areas	National Scenic Areas	National Recreation Area	Wild and Scenic Rivers	Other Congressionally Designated Areas (FS)[1]	National Monuments	Wilderness Study Areas	National Roadless Areas (FS)[2]
Rio Grande National Forest	430,173	0	0	0	1,410	0	0	669,024
Rogue River-Siskiyou National Forests	75,877	0	0	11,748	0	0	0	30,503
Salmon-Challis National Forest	1,209,036	0	28	11,812	0	0	0	2,264,053
San Bernardino National Forest	130,535	0	0	0	0	0	0	223,329
San Juan National Forest	423,902	0	0	0	62,355	0	0	696,594
Santa Fe National Forest	283,542	0	44,680	12,916	0	0	0	374,307
Sawtooth National Forest	217,724	0	566,454	0	0	0	0	1,227,815
Sequoia National Forest	275,549	0	0	9,282	0	192,228	0	422,243
Shasta Trinity National Forest	35,231	0	0	0	13,112	0	0	35,335
Shoshone National Forest	225,036	0	0	0	6,870	0	0	68,171
Sierra National Forest	259,672	0	0	0	0	0	0	99,746
Tahoe National Forest	2,353	0	0	0	0	0	0	32,902
Tongass National Forest	647,656	0	0	0	300,918	0	0	948,574
Tonto National Forest	127,728	0	0	0	0	0	0	25,868
Uinta National Forest	41,396	0	0	0	0	0	0	147,652
Umatilla National Forest	297,671	0	0	6,636	0	0	0	267,459

Table K-2
Special Designation Areas on FS Lands within the Planning Area

Forest	Acreage							
	Congressional Designations						Administrative Designations	
	Wilderness Areas	National Scenic Areas	National Recreation Area	Wild and Scenic Rivers	Other Congressionally Designated Areas (FS)[1]	National Monuments	Wilderness Study Areas	National Roadless Areas (FS)[2]
Umpqua National Forest	71,447	0	0	554	37,007	0	0	61,822
Wallowa-Whitman National Forest	372,188	0	625,070	20,381	0	0	0	514,674
Wasatch-Cache National Forest	104,974	0	0	0	0	0	0	245,945
White River National Forest	748,147	0	0	0	0	0	0	639,602
Willamette National Forest	391,235	0	0	41,911	18,896	0	0	166,415
Total	**19,057,887**	**180,299**	**1,709,808**	**310,140**	**1,177,521**	**247,728**	**788,597**	**31,457,013**

[1] "Other Congressionally Designated Area" is a designation utilized solely by USFS Region 5 (Alaska)
[2] "National Roadless Area" is a FS-specific designation

Source: FS 2008a

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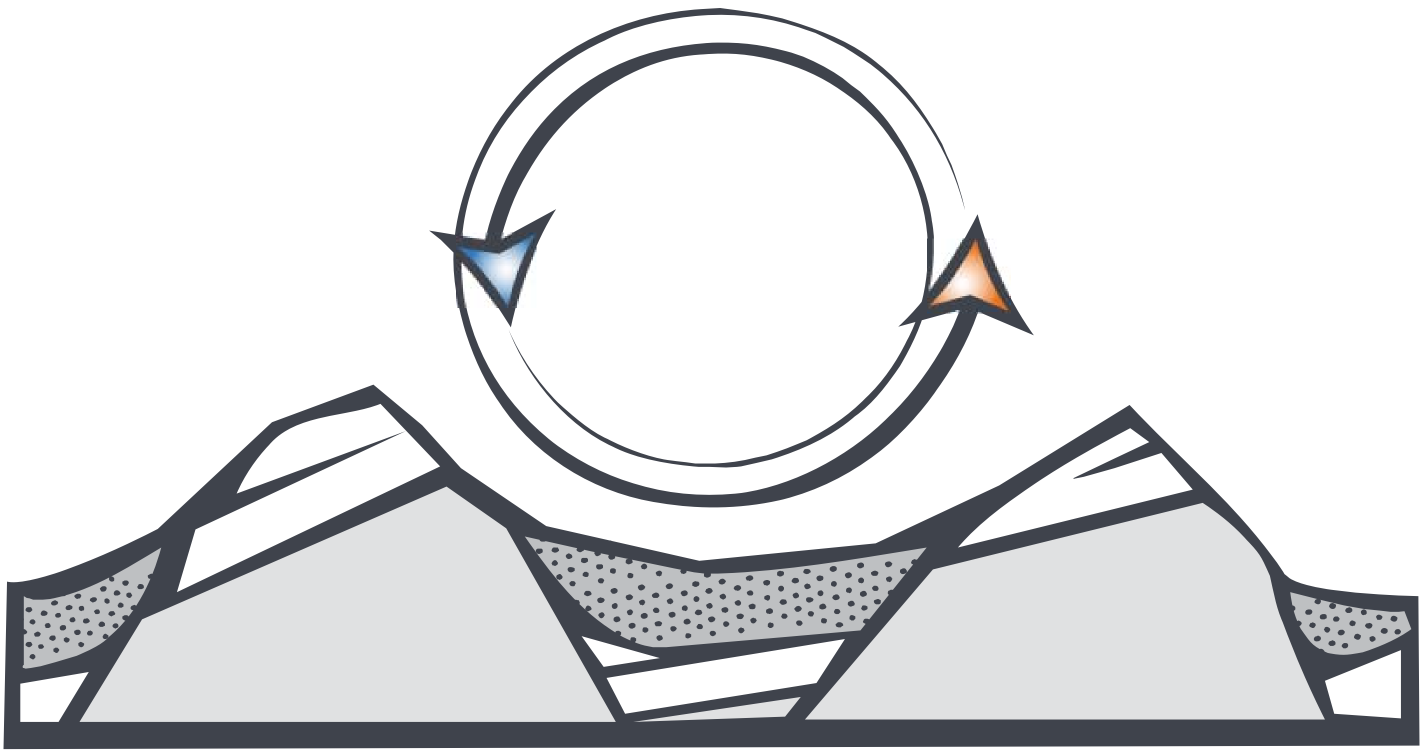

Appendix L

Public Comments and Comment Analysis

APPENDIX L
PUBLIC COMMENTS AND COMMENT ANALYSIS

1. Method of Comment Collection and Analysis

Methods of submitting comments included letters, facsimiles, and electronic mail messages. All comments, regardless of how they were submitted, received equal consideration.

Letters were tracked as they arrived, registering the author's name and affiliated organization, if applicable. After entering submissions in a tracking list, all were read and evaluated to determine their content. Most submissions contained several individual comments, thus, it was necessary to develop a method to systematically track all individual comments received. This was accomplished through a system in which individual comments within a longer letter or comment form were numbered for tracking purposes. Individual comments were tallied and analyzed, and written submissions were registered in the administrative record.

2. Summary of Written Comments Received

The comment period closed on September 19th, 2008. All written comments sent prior to midnight (12:00 A.M. on September 19th, 2008) were accepted as official comments. Some comments were duplicated within an electronic mail message and a letter submitted via US Mail. Identical, duplicate comments from the same party were not considered more than once.

A total of 74 written submissions were received. Most of the submissions contained multiple comments on different topics. A total of over 500 individual comments were made. All information received through these comments has been evaluated, verified, and incorporated into the Final PEIS as appropriate.

Copies of all accepted written submissions, excluding attachments and appendicies are provided in this Appendix, followed by the agency response.

Each comment is coded using the affiliated organization type, the letter number, and the comment number within the letter. Affiliation types include A (government agency or tribal organizations), I (individual), O (non-profit organization), and C (commercial business or industry organization). The two form letters were received from groups of individuals, and were classified as F (form letter). A vertical line and the comment code note each separate comment within each submission. The agency response to each comment is printed following the comment letter. Everyone who submitted a unique comment letter is included in the commentor index (Table L-1, Comment Letters Received by Author Name), which includes last name, first name, affiliated organization (if applicable) and letter ID. A separate index is provided in which letters are organized alphabetically by affiliated organization (Table L-2, Comment Letters Received by Affiliated Organization).

In addition, form letters with identical or nearly identical comments were received from over 700 individuals on two topics. Individual commentor's names and addresses were recorded, but identical duplicate comments were not responded to more than once. Representative letters for each of the two topics are published in this Appendix. Individuals who submitted a form letter will be directed to the representative letter.

Table L-1
Comment Letters Received by Author Name

Commentor Name	Affiliated Organization	Letter Code
Multiple commentors	n/a FORM LETTER A	F-34
Multiple commentors	n/a FORM LETTER B	F-40
Alvarez, Raymond	Hewisedawi Band of Pit River Indians	A-46
Arnold, Gary	Arnold, Bleuel, Larochelle, Mathews and Zirbel LLP	I-1
Arnold, Gary	Arnold, Bleuel, Larochelle, Mathews and Zirbel LLP	I-2
Banks, Kevin	Alaska Department of Natural Resources	A-56
Barr, Ronald	Earth Power Resources, Inc	C-50
Becker, Dave	Oregon Natural Desert Association	O-42
Berditschevsky, Michelle	Pit River Tribe	A-61
Boggs, Denise	Conservation Congress	O-22
Bromm, Susan	U.S. Environmental Protection Agency	A-45
Canaly, Christine and Smith, Ceal	San Luis Valley Water Protection Coalition and San Luis Valley Ecosystem Council	O-74
Culver, Nada	Wilderness Society	A-58
Davidson, Patty	n/a	I-66
D'Olier, William L.	n/a	I-37
Eastman, Trudy	n/a	I-71
Emmerich, John	Wyoming Department of Game and Fish	A-23
Etchepare, John	Wyoming Department of Agriculture	A-24
Fite, Katie	Western Watersheads Project	A-6
Fite, Katie	Western Watersheads Project	A-9
Fleischmann, Daniel	Ormat Nevada Inc.	C-54
ForestDavis, Olivia	Hewasi Band Pit River Tribal Member	I-68
Fraser, Rob	Idaho Wilderness Federation	O-60

Table L-1
Comment Letters Received by Author Name

Commentor Name	Affiliated Organization	Letter Code
Gawell, Karl	Geothermal Energy Association	C-16
Gillerman, Virginia	Idaho Geological Survey	A-8
Goin, Wayne	Minion Hydrologic	C-26
Guenther, Herbert R.	Arizona Department of Water Resources	A-64
Hayden, Deborah	Swiftcurrent Ventures	C-18
Heiken, Doug	Oregon Wild	O-49
Hoyle, Joe W	n/a	I-52
Jackson, Irene	n/a	I-25
Jackson, Irene	n/a	I-32
Johnson, Stephen	Dunton LLC.	C-48
Kames, Renee	n/a	I-65
Karnes, A	n/a	I-69
Kessell, Mark	n/a	I-67
Kezar, Chuck	n/a	I-51
Kjellander, Paul	Idaho Office of Energy Resources	A-44
Lovekin, James	GeothermalEx, Inc.	C-17
Lovelace, Bonnie	Montana Department of Environmental Quality	A-31
Magnusson, Arni	Glitner Sustainable Energy	C-4
Mansure, Chip	n/a	I-14
Mattson Mc Donnald, Pamela	n/a	I-10
McKee, Michael	Uintah County	A-59
Mitchell, D. Kjell	Glenwood Springs Hot Springs Lodge and Pool	C-20
Murawski, Helene	n/a	I-36
Nash-Chrabascz, Bridget	Quechan Indian Tribe	A-33
Niggemann, Kim	Nevada Geothermal Power Inc	C-13
Pace, Sam	Saguache County Commissioners	A-27
Painter, Janie	Save Medicine Lake Coalition	O-55
Perry, Douglas	Davenport Power LLC	C-19
Prisament, Morty	Tetra Tech	C-11
Purves, Cathy	Trout Unlimited	O-47
Ranger, Richard	API energy	C-43
Ritter, Ginger	Arizona Game and Fish Department	A-29
Ronnerud, Phil	Greenlee County, AZ	A-12
Seeber, Theodore	n/a	I-3
Shockey, Diane	n/a	I-63
Shott, Jim	Medicine Lake Citizens for Quality Environment Inc.	O-70
Sifford, Alex	Sifford Energy Services	C-38
Simmons, Patricia	n/a	I-39
Stansell, Stan	U.S. Fish and Wildlife Agency	A-73
Sullivan, Patrick	n/a	I-15
Sulock, Dot	n/a	I-5
Thrash, Gary	San Juan Public Lands Center	O-41
Tolbert, Krista	n/a	I-28
Von Seggern, David	Great Basin Sierra Club	O-30
Walsh, Stan	Sauk-Suiattle Indian Tribe	A-72
Jones-Weinberger, Carolyn	n/a	I-62
Wenk, Dan	National Park Service	A-57
Wilmoth, Stan	Montana Historical Society	O-7

Table L-1
Comment Letters Received by Author Name

Commentor Name	Affiliated Organization	Letter Code
Witcher, James	n/a	I-53
Wunder, Matthew	New Mexico Department of Game and Fish	A-21
Wyncoop, Eileen	Sierra Pacific Resources (Nevada and Pacific Power)	C-35

Table L-2
Comment Letters Received by Affiliation of Author

Affiliated Organization	Letter Code
Alaska Department of Natural Resources	A-56
API energy	C-43
Arizona Department of Water Resources	A-64
Arizona Game and Fish Department	A-29
Conservation Congress	O-22
Davenport Power LLC	C-19
Dunton LLC.	C-48
Earth Power Resources, Inc	C-50
Geothermal Energy Association	C-16
GeothermalEx, Inc.	C-17
Glenwood Springs Hot Springs Lodge and Pool	C-20
Glitner Sustainable Energy	C-4
Great Basin Sierra Club	O-30
Greenlee County, AZ	A-12
Hewisedawi Band of Pit River Indians	A-46
Idaho Geological Survey	A-8
Idaho Office of Energy Resources	A-44
Idaho Wilderness Federation	O-60
Medicine Lake Citizens for Quality Environment Inc.	O-70
Minion Hydrologic	C-26
Montana Department of Environmental Quality	A-31
Montana Historical Society	O-7
National Park Service	A-57
Nevada Geothermal Power Inc	C-13
New Mexico Department of Game and Fish	A-21
Oregon Natural Desert Association	O-42
Oregon Wild	O-49
Ormat Nevada Inc.	C-54
Pit River Tribe	A-61
Quechan Indian Tribe	A-33
Saguache County Commissioners	A-27
San Juan Public Lands Center	O-41
Sauk-Suiattle Indian Tribe	A-72
Save Medicine Lake Coalition	O-55

Table L-2
Comment Letters Received by Affiliation of Author

Affiliated Organization	Letter Code
Sierra Pacific Resources (Nevada and Pacific Power)	C-35
Sifford Energy Services	C-38
Swiftcurrent Ventures	C-18
Tetra Tech	C-11
Trout Unlimited	O-47
U.S. Environmental Protection Agency	A-45
U.S. Fish and Wildlife Agency	A-73
Uintah County	A-59
Western Watersheads Project	A-6
Western Watersheads Project	A-9
Wilderness Society	A-58
Wyoming Department of Agriculture	A-24
Wyoming Department of Game and Fish	A-23

Comments on the PEIS were concerned with a number of issues including but not limited to: scope of the document, identification of lands available for leasing, and incorporation of site specific stipulations and BMPs. In addition, comments were received for the following resources and resources uses: air quality, cultural resources, fish and wildlife, geologic and seismic resources, livestock grazing, land use and special designations, minerals and energy, noise national scenic and historic trails, recreation, socioeconomics and environmental justice, special status species, tribal interests, vegetation, visual resource, and water resources.

3. Comment Letters and Responses

All unique comment submissions and representative form letters are included below. Reponses can be found immediately following each letter.

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June 20, 2008

Geothermal PEIS
c/o EMPS, Inc.
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San Francisco, CA 94105

Re: PEIS

Gentlemen:

Please add the undersigned to the mailing list in connection with all matters involving the Draft Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States ("PEIS"). Please provide to me all notices and other documentation which may be disseminated to the public in connection with the PEIS.

I would like to take this opportunity to provide some initial comments with respect to the PEIS. I am the attorney for Little Lake Ranch, located in the southerly portion of the Owens Valley of the County of Inyo, California. Little Lake's property is located very close to the Coso Geothermal Plant and a separate geothermal exploration project being conducted by Deep Rose, LLC, or its successor, Deep Rose Geothermal 16, LLC. Both projects are located within the jurisdiction of the Ridgecrest Office of the Bureau of Land Management ("BLM"). The property at Little Lake is approximately 1200 acres in size and contains a 90 acre lake, a series of ponds connected by flowing streams and interrelated wetlands that provide habitat for numerous species of migratory fowl, wildlife and flora. Little Lake depends upon the underground water aquifer known as the Rose Valley Water Basin to supply all of its water needs, as there is no surface water in the area.

By virtue of the manner in which Coso designed and has operated its geothermal facility, Coso is depleting the geothermal reservoir of fluids on which it relies to produce the steam and fluids to operate its facility. Because of the large and steady decline of fluids in the geothermal reservoir, Coso is seeking to import water from the Rose Valley Water Basin on which Little Lake relies for its water. According to Coso's own hydrologic studies, Coso's importation of water from the Rose Valley Water Basin could cause substantial environmental impacts upon the Little Lake property, including its lake, surrounding wetlands, habitat and wildlife.

The PEIS is largely lacking in any discussion or analysis concerning the proper utilization of geothermal resources. Notably, there is little to no consideration of alternate technologies by which the geothermal reservoirs are managed to allow for the sustainable production of electricity through the conservation of geothermal fluids by the proper design and operation of the production facilities themselves.

The difficulties of The Geysers operation located in Napa Valley, California, are illustrative. When geothermal production declined at The Geysers due to the loss of water within its geothermal reservoir, The Geysers was forced to import reclaimed water from at least two alternate sewage treatment plants for injection to replenish the underground geothermal reservoir. It would be prudent for any environmental analysis concerning the exploration, development and operation of a geothermal plant to consider the long-term management of the geothermal reservoir to limit or completely avoid the need for imported water. I-1-1

There is no question but that water is a very rare and precious commodity in most of the western United States,. Large portions of the western United States are subject to current drought conditions. Consumers are being asked to conserve the water they use. Geothermal facilities should be designed, constructed and operated in a manner to avoid the need for imported water and to balance the production of geothermal fluids to the natural recharge of the geothermal resource.

One possible explanation of the problems experienced at Coso and other geothermal facilities is their use of water-cooling towers to condense the steam used in the electricity generation process. Unfortunately, by utilizing water-cooling towers, Coso and other geothermal facilities lose a tremendous amount of the geothermal fluids produced, thereby causing a more rapid depletion of the fluids in the geothermal reservoir. There is no consideration in the PEIS of available alternatives, such as the utilization of an air-cooled system by which 100% of the geothermal fluids can be retained within the system and re-injected into the geothermal reservoir. This alternative may prolong the life of the reservoir and allow for a more sustainable production of electricity from the geothermal plants. I-1-2

Similarly, the PEIS does not address the preservation of the geothermal reservoirs through proper long-term management. First, there is no mention of the need to balance the natural recharge of the geothermal reservoirs, compared to the consumption of the fluids from the electrical plants. Second, there is no consideration of the proper size and production capability of an electrical plant to reduce water consumption. In either case, a proper management of the resource could eliminate the need for imported water and allow for a more sustained production over a longer period of time. I-1-3

The reliance upon imported water, even treated wastewater such as occurs at The Geysers, is a short-sighted and environmentally risky answer to geothermal reservoir depletion. Because of the scarcity of water throughout the western United States, perhaps such water resources could be better used, rather than simply injecting water into a geothermal reservoir to produce energy. The PEIS should address the availability of local water sources for injection, whether such water sources are adequate to supply all competing needs and uses of any projected water used for injection, and whether the imported water source is naturally replenished. I-1-4

Without a full consideration of alternative technologies, such as air-cooled mechanisms or other engineering designs to reduce the use of water and increase the amount of the geothermal fluids used for injection, the PEIS does not adequately study and comment upon appropriate and prudent steps to mitigate the depletion of water resources. The possible depletion of geothermal reservoirs, and any plans to import water from the surrounding surface and groundwater sources should be considered in all planning stages. I-1-5

Very truly yours,

ARNOLD, BLEUEL, LAROCHELLE,
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Gary D Arnold

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GDA:jw
cc: BLM-Ridgecrest
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I-1-1

The PEIS covers geothermal leasing. Issuance of a lease does not require the lease holder to specify what kind or size of plant would be developed on the lease site; therefore, discussion of alternate technologies is not appropriate in this analysis (see Section 1.11.1, *BLM and FS Decisions to be Made Following Subsequent NEPA Analysis* for further discussion of permitting). All development and utilization and reclamation activities would be subject to further site-specific permitting and environmental analysis. Site-specific impacts on water resources, including water importation, would be addressed as part of the environmental analysis for the permitting process.

I-1-2

As noted in the above response, the PEIS covers geothermal leasing. Issuance of a lease does not require the lease holder to specify what kind or size of plant would be developed on the lease site; therefore, discussion of alternate technologies is not appropriate in this analysis (see Section 1.11.1, *BLM and FS Decisions to be Made Following Subsequent NEPA Analysis* for further discussion of permitting).

I-1-3

Prior to leasing, the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states typically manage and have regulatory authority for water quality, water rights, and wildlife. Site-specific impacts on water resources, including groundwater and water importation, would be addressed as part of the environmental analysis for the permitting process. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis. BLM and FS would work with interested and affected parties to identify and resolve resource conflicts. Appropriate site-specific mitigation would be developed, as necessary.

I-1-4

See above response for comment I-1-3.

I-1-5

As noted above, issuance of a lease does not require the lease holder to specify what kind or size of plant would be developed on the lease site; therefore, discussion of alternate technologies is not appropriate in this analysis (see Section 1.11.1, *BLM and FS Decisions to be Made Following Subsequent NEPA Analysis* for further discussion of permitting). All development and utilization and reclamation activities would be subject to further site-specific permitting and environmental analysis.

Site-specific impacts on water resources, including groundwater and water importation, would be addressed as part of the environmental analysis for the permitting process. BLM and FS would work with interested and affected parties to identify and resolve resource conflicts. Appropriate site-specific mitigation would be developed as necessary.

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June 30, 2008

Geothermal PEIS
c/o EMPS, Inc.
182 Howard Street, Suite 110
San Francisco, CA 94105

Re: PEIS

Gentlemen:

I am the attorney representing Little Lake Ranch, Inc. ("LLR"). LLR owns approximately 1,200 acres of land located within the Rose Valley portion of the southern Owens Valley, Inyo County, California. The LLR property contains a navigable body of water known as Little Lake which is approximately 100 acres large. Flowing south from Little Lake is a series of separate ponds, streams, springs and water features. This area further contains associated riparian habitat, wetlands and a vast environmentally sensitive area hosting numerous species of vegetation and wildlife. Migratory fowl depend on Little Lake.

The Little Lake property lies approximately 9 miles southwest of the current geothermal operating plant ("Electrical Plant") managed by Coso Operating Company ("Coso"). Coso has filed an application with the County of Inyo ("County") requesting permission to pump approximately 4,800 acre-feet of water per year from property it purchased within the Rose Valley and transport the water to the Coso Electrical Plant for purposes of injection. According to Coso's own hydrology consultants, such water pumping and transportation project ("Project") could result in the loss of over 60% of the water resources available to LLR. Such an enormous loss of water could cause catastrophic impacts to the Lake, the surrounding wetlands and riparian habitat, and all of the vegetation species and wildlife on which they depend. County is currently processing an Environmental Impact Report ("EIR") under the California Environmental Quality Act. The Project further requires a right-of-way ("ROW") from the Bureau of Land Management ("BLM") to transport the water over federal lands.

During this planning process for the Project, LLR has become much more aware and sensitive to the environmental impacts which may be caused by the siting, location, design, and operation of geothermal facilities operated for the production of electricity. Although the EIR on the pending Project has not yet been released for public review or comment, we are concerned that the EIR will not adequately discuss a number of environmental concerns. Similarly, the Pending

Environmental Impact Statement for Geothermal Leasing ("PEIS") fails to identify, discuss, evaluate or mitigate some crucial impacts as more particularly identified below. While some of the factors noted are measured and influenced by site-specific conditions in relationship to a particular geothermal reservoir, the PEIS should identify all of the environmental issues below and make sure that any site-specific environmental assessment for a specific leasing application should address them in detail.

While the extent of any available geothermal resource is largely unknown during the exploration stage, the existence of the resource will be identified, but its size and composition should be estimated. The amount of electrical production from the geothermal resource should be based upon the size and extent of the reservoir so as to create a sustainable facility. This may reduce the immediate production of electrical energy, but allow for a greater and longer term utilization of the resource, with fewer impacts on the environment as noted below. I-2-1

The PEIS does not evaluate in any fashion the environmental impacts from the alternate designs of available geothermal facilities. The principal designs currently include single-flash systems, double-flash systems, dry steam (depending upon the actual geothermal resource available), binary and any number of hybrid designs incorporating one or more of the foregoing. More exotic designs may further utilize combinations of other energy production methods (fossil fuel, hydroelectric, solar, wind, biomass, etc.), each of which alternate designs pose different environmental impacts. Absent an identification of the projected design of the geothermal facility, it is virtually impossible to accurately assess the ultimate environmental impacts from the utilization of the geothermal resource. I-2-2

Of the 7 identified geothermal leasing applications which are now pending and addressed in the PEIS, 5 of them propose binary systems. There are no designs referenced with respect to the other 2. The PEIS should identify each alternative design and identify the particular environmental impacts associated with each form of a design. Indeed, each and all of the designs should be further analyzed to conserve the geothermal resource itself, as well as minimizing any impacts to the environment each of the alternative designs may pose. Each design should consider how toxic emissions will be minimized and the use of water conserved. I-2-3

The PEIS mentions possible impacts to underground water sources, typically consisting of known underground water basins or aquifers. The PEIS does not separately address or evaluate situations wherein the geothermal reservoir exists as a separate and distinct water basin. In most cases, the geothermal reservoir, containing heated water or steam, or both, (hereafter called herein "GeoReservoir") exists in the form of a water basin, but it is generally separate and distinct from underground water basins/aquifers ("Water Basins"), which are used by the overlying owners for drinking water, irrigation, domestic uses and other typical residential, agricultural, industrial and commercial uses. As such, there can be much confusion between the relationship in the PEIS of these separate resources. While there may be some hydrological connection between the GeoReservoir and the Water Basins, the PEIS does not identify the distinction, nor really evaluate what impacts the use and consumption of the GeoReservoirs may have on the local Water Basins. I-2-4

Are there any connections? If so, what are the environmental impacts? If not, will the Water Basins be used for make-up water in the geothermal plant, and what impacts would this cause on the surrounding environment?

Because of Coso's design of its facility, it has overextended its geothermal reservoir. The reservoir is being consumed and drying out. Thus, Coso seeks water from the Water Basins located within the Rose Valley, to the detriment of LLR and others in the community. This is just one example of an environmental impact, much like The Geysers importation of wastewater.

Depending upon the selected design of any geothermal facility, it may require imported water to reach sustainability. This is exactly the case of the The Geysers, and it is also the case in numerous other geothermal facilities around the world. The PEIS should consider as an environmental impact the exploitation of a GeoReservoir and the possible need for imported water to reach sustainability. What if the water sources are not readily available or may only lead to mounting environmental problems? I-2-5

Many geothermal facilities rely upon water cooling towers ("WCTs") to cool working fluids in a binary plant or steam condensate in dry steam, single flash and double flash facilities. In so doing, a substantial portion of the steam (approximately 85% according to published sources) is lost to evaporation during the cooling process, thereby limiting the geofluids which could otherwise be injected.

The PEIS fails to adequately identify throughout the document the different type of fluids that are contained in a GeoReservoir. Numerous different terms are used interchangeably, but should not be. There are discussions of steam, geofluids, liquids, fluids and the like. It is not correct to say that all fluids produced at a hypothetical geothermal facility are available for re-injection. Geofluids or fluids can be composed of both liquid and steam. While generally the liquids can be re-injected, that portion of the original geofluids which is steam, may not be re-injected, if the design of the facility uses WCT. Because 85% of the steam component is lost to evaporation in the WCT, a similar large amount of the original geofluids may <u>NOT</u> be available for re-injection. This confusion from the use of suspect terminology should be clarified. I-2-6

The PEIS should consider the environmental impacts from allowing WCTs when compared to systems relying upon air-cooled condensers ("ACCs"). The ACC systems would allow for 100% of the geofluids produced at a geothermal plant to be injected, because there are no evaporation losses of the original steam. By eliminating water loss through the WCTs, the geothermal resource can be better preserved, resulting in more sustainable production and minimizing impacts on available water sources. I-2-7

If the WCT design facilities are evaluated, then the PEIS needs to further consider and evaluate where the make-up water will originate and what impacts the use of such imported water will have on the region from which the make-up water is taken. For instance, The Geysers relies upon wastewater imported from 2 sewage recycling plants. While this may be an admirable use of I-2-8 wastewater which perhaps would not otherwise be utilized, many recycling projects are under way throughout California and at other arid climates to make use of recycled water. The commitment of such imported water resources to geothermal plants will then cause impacts from, and prevent other uses of, such recycled water in the areas from which they are taken. What consideration or evaluation should be made of this situation?

Similarly, and particularly in arid areas, the importation of water from either surface water or surrounding Water Basins may have severe impacts upon the area from which the water is taken. Such water will no longer be available to preserve vegetation, natural habitats, riparian areas, and wetlands. Not only may the habitat suffer, but the wildlife which depends on such habitat may also be impacted. I-2-9

In all cases, the design of the geothermal facility is critical in determining what consequences may arise from water utilization at the geothermal plant. A realistic assessment of environmental impact cannot be made until the design of the plant is known and studied among competing alternatives. The PEIS should note these differences and make sure that these impacts are studied on each and every proposed geothermal lease. I-2-10

In 2 of the 7 pending lease applications being reviewed for environmental assessments, no mention is made of the type of geothermal plant. This should be corrected and the impacts mentioned above should be evaluated. I-2-11

Another possible environmental impact has not even been mentioned. All energy-producing plants emit heat to the atmosphere and environment. This is a natural consequence of power production. Indeed, geothermal power plants emit considerably more heat per unit of energy produced than most power plants, including fossil fuel and nuclear. (See DiPippo, *Geothermal Power Plants, Principals, Applications, Case Studies and Environmental Impact*, Second Edition, 2008, at page 406). I-2-12

The foregoing are broad conceptual problems with the PEIS. The following comments will more specifically identify portions of the PEIS which should be corrected, clarified or supplemented by appropriate study and analysis.

At Page 2-35, Table 2-7, the projected MW production at the Coso area in the year 2015 is 75 MW and 150 MW at the year 2025. However, Coso's current rated capacity is around 270 MW, although its actual production may be less. What accounts for this substantial reduction in current capacity, or is this table in error? I-2-13

The PEIS states a typical 50 MW plant would utilize a site area of between 20 to 25 acres to accommodate needed equipment, of which the power plant itself would occupy 25% of the area for a water-cooled plant, or about 50% for an air-cooled plant (Section 2.5.1, Page 2-45). Clarify whether an air-cooled plant would require more land, or just use more to the noted site. I-2-14

The PEIS asserts that most geothermal fluids produced are re-injected back into the geothermal reservoir. In flash-steam facilities, about 15-20% of the fluid would be lost due to flashing to steam and evaporation. Binary power plants utilize a closed-loop system and the geofluids are re-injected with no fluid loss (Page 2-47). This also perpetuates a very loose definition of "fluids." Actually, 85% of the steam used in flash or dry-steam plant is lost to evaporation, when a water-cooled tower is used. Moreover, depending on the type of GeoResource, the percentage of steam produced, and the type of cooling system, the statements are very misleading. The total loss of the "fluids" depends on both the nature of the produced geofuilds, and the type of cooling system, and whether the plant actually re-injects the available fluids. This should be clarified and discussed. I-2-15

Impacts on geologic resources and seismic issues were evaluated. The high pressure injection of fluids directly into fault zones has been related to increases in seismic activities (Section 4.3.2, Page 4-18). The PEIS then notes that the high pressure injection of fluids from outside the geologic system is not the same as where geothermal fluids are withdrawn and then re-injected for a near zero net change, and would represent a much lower risk of increasing seismic activity (Page 4-19). This conclusion ignores the dramatic loss of heated liquids from evaporation when WCTs are employed at the facility for cooling purposes. Indeed, if there is no source of make-up water from nearby surface waters or Water Basins, and a WCT system is used, then the GeoReservoir can be substantially depleted of water over time, actually increasing the possibility of seismic activity. I-2-16

The PEIS notes that subsidence can also occur when groundwater is pumped from underground aquifers at a rate exceeding the rate at which it is replenished. Since geothermal development includes re-injection of the geothermal fluids, it is assumed that the potential for subsidence is low (Section 4.3.2, page 4-19). For the same reasons discussed above, this conclusion ignores the dramatic loss of heated liquids from evaporation when WCTs are used, and there is a high portion of steam in the geofluids. I-2-17

At Section 4.7.3, Page 4-44, the PEIS does mention that geothermal resource utilization could affect groundwater resources because of consumption of water by evaporation and the need to re-inject water to replenish the geothermal reservoir. It is noted that the availability of water resources could be a limiting factor which may affect the expansion of a geothermal resource in a given area. Make-up water is used sometimes to replace the evaporative losses and blowdown in a water-cooled system. While the PEIS notes the impacts, it does not consider appropriate mitigation measures to reduce the need for make-up water, by the design of the plant. I-2-18

The source of cooling water could be either surface water or groundwater (Page 4-44). During operations, most geothermal fluids produced are re-injected. In flash-steam facilities, about 15-20% of the fluid would be lost due to flashing to steam and evaporation, while binary plants are non-consumptive and use a closed-loop system (Page 4-44). These conclusions are not accurate. Even binary plants use cooling plants, and if they rely on water cooling systems, then make-up water for the cooling must be imported and evaporated, thereby consuming valuable water resources. Moreover, the estimate of a 15-20% loss of the original produced geofluids may be I-2-19 accurate, depending on the composition of the geofluids, but is enormously understated as the level of steam produced as part of the geofluids increases, such as at The Geysers.

The PEIS finally discusses the use of air-cooled systems at Page 4-45. Air-cooled systems use less cooling water and are more common in arid regions. Air-cooled systems would have fewer impacts associated with cooling water. The comparisons among various designs, and how they affect the environment, should merit more discussion and analysis. I-2-20

Section 4.10 discusses the various impacts upon fish and wildlife. Primarily, the impacts would be associated with the elimination or degradation of wildlife habitat at project sites in immediately adjacent areas, or within the watershed (Page 4-73). Such degradation could also be due to water usage from areas from which water is imported for injection. This should be mentioned. I-2-21

There is some acknowledgment that geothermal power production could deplete the thermal energy and water from the geothermal reservoirs. (Page 5-27). To minimize this impact, it is simply noted that the super-hot water extracted from the reservoirs could be injected back into the reservoir, but it also notes that over time the resources could be depleted to uneconomic levels. (Page 5-27). Shouldn't the PEIS discuss reduction of power production and the use of other alternatives to minimize or prevent these results? I-2-22

Sections 5.4.8, 5.4.9 and 5.4.10 deal with cumulative impacts to vegetation, fish and wildlife, and endangered species. In each case, the impacts are generally limited to the actual operation of the geothermal plant without consideration of water losses leading to direct impacts on these resources. I-2-23

Chapter 15 discusses the geothermal leasing project within the Mt. Hood National Forest, Prineville Field Office, Oregon. The applicant expects to develop 2 geothermal power plants, 1 consisting of a 30 MW plant and the other a 20 MW plant (Section 15.2.4, Page 15-10). No mention is made of the intended design or type of the geothermal facility. Shouldn't part of the environmental analysis include the actual type of geothermal facility so that its specific impacts upon water resources, habitat and biological resources can be identified and calculated? I-2-24

Chapter 16 discusses the geothermal leasing application within the Willamette National Forest, Salem District, Oregon. The proposal is to ultimately develop 2 power plants, 1 a 30 MW plant and the other a 20 MW plant (Section 16.2.4, Page 16-9). Neither the design or type of the geothermal facility is mentioned, nor its water consumption considered. Shouldn't part of the environmental analysis include the actual type of geothermal facility so that its specific impacts upon water resources, habitat and biological resources can be identified and calculated? I-2-25

Appendix C is a listing of certain areas within the study area which are considered an Area of Critical Environmental Concern ("ACEC"). Interestingly, there are no areas in California listed. While perhaps an oversight or omission, why are no California sites listed within Appendix C? I-2-26

Appendix D is entitled "Best Management Practices" and it provides a summary of the typical requirements that should be adopted and imposed as mitigation measures for environmental impacts. The Best Management Practices ("BMP") are stated to be state-of-the-art mitigation measures applied on a site-specific basis to reduce, prevent or avoid adverse environmental or social impacts (D-1).

Consider the specificity of the BMPs directed to the protection of visual resources (D-46-51). Then, compare the limited and almost non-existent BMPs regarding the protection of water resources, the habitat, wildlife, pollution and other major possible impacts from geothermal facilities. It is suggested that more specific BMPs be adopted regarding the design of geothermal plants, the projected production of geofluids when compared to the capacity and nature of the GeoReservoir, the methods employed to conserve water resources and the GeoReservoir, and each of the other environmental impacts noted in the PEIS. Just as importantly, the PEIS and the BMPs adopted therein, should include specific standards and practices designed to achieve a long-term sustainable production plant, without sacrificing the environmental conditions in which the plant is located. I-2-27

Appendix H is entitled "Federally Listed Species." The Mojave Ground Squirrel is not listed, but it is a California-designated endangered species. Shouldn't the PEIS list all of the state-protected species as well? I-2-28

Thank you for the opportunity to comment upon the PEIS. The geothermal resources themselves are an environmental asset and the impact to the resource should also be studied and protected. They should not be overextended or wasted. I look forward to receiving answers to these questions and observations as well as the revised PEIS.

Very truly yours,

ARNOLD, BLEUEL, LAROCHELLE,
MATHEWS & ZIRBEL, LLP

Gary D. Arnold

Gary D. Arnold

GDA:jw
cc: BLM-Ridgecrest
Little Lake Ranch
County of Inyo

I-2-1

The PEIS covers geothermal leasing. Issuance of a lease does not require the lease holder to specify what kind or size of plant would be developed on the lease site; therefore, discussion of alternate technologies is not appropriate in this analysis (see Section 1.11.1, *BLM and FS Decisions to be Made Following Subsequent NEPA Analysis* for further discussion of permitting). All development and utilization and reclamation activities would be subject to further site-specific permitting and environmental analysis.

I-2-2

The PEIS covers geothermal leasing. Issuance of a lease does not require the lease holder to specify what kind or size of plant would be developed on the lease site; therefore, discussion of alternate technologies is not appropriate in this analysis (see Section 1.11.1, *BLM and FS Decisions to be Made Following Subsequent NEPA Analysis* for further discussion of permitting). All development and utilization and reclamation activities would be subject to further site-specific permitting and environmental analysis.

I-2-3

The PEIS covers geothermal leasing. Issuance of a lease does not require the lease holder to specify what kind or size of plant would be developed on the lease site; therefore, discussion of alternate technologies is not appropriate in this analysis (see Section 1.11.1, *BLM and FS Decisions to be Made Following Subsequent NEPA Analysis* for further discussion of permitting). All development and utilization and reclamation activities would be subject to further site-specific permitting and environmental analysis.

I-2-4

The geothermal lease is for the heat in the federal mineral estate. Unless specifically owned in fee, the fluid part of the resource falls under state laws. Therefore, the amounts of fluid that can be extracted or injected is subject to the individual states' allocation programs, as is the use of other groundwater or surface water sources. The water rights to these fluids, and whether there are better uses for them, is not the subject of this PEIS. The potential for depletion of other sources would be part of the evaluation of each individual lease.

The PEIS does discuss potential water quality impacts to the geothermal resource and other groundwater and surface water sources from the geothermal activities.

Where the geothermal resource includes both heat and fluids (water, steam, or a mix), these resources may or may not be hydrologically connected with local and regional aquifers. Where they are connected, the depletion of fluids from the geothermal resource could impact the availability of water from the other sources of groundwater, or in rare cases, even surface water (e.g., hot springs). More commonly, the reservoir pressure is easier to maintain in situations where the geothermal reservoir is naturally recharged via a connection to the surface. Local conditions would determine the manner and degree to which the systems are hydrologically connected. However, this would not occur (i.e., there is no water loss or drawdown of the geothermal reservoir) in binary situations (most existing plants), because the system is a closed loop that recaptures all water and condensate for reinjection into the same reservoir it is drawn from; the goal is to maintain reservoir pressure. In every case, the operator is required to protect other aquifer zones from mixing or being depleted.

Where the geothermal resource is not connected with other groundwater systems, there is little likelihood that depletion of fluids from the geothermal resource would directly impact the availability of water from the other groundwater systems. The use of other water resources to "replenish" the geothermal resource using other sources is only necessary in the case of "flash" or steam-run plants, which are rare, and would be subject to subsequent allocation permit decisions at the state and federal level. Any new action would also have to comply with environmental laws.

The PEIS discusses the amount of geothermal fluid lost to the system due to emission of steam and cooling losses. New language has been added to state that the generation of electrical power through geothermal energy from flash plants requires the use of varying amounts of water from other sources for cooling purposes depending on the technology used, the temperatures involved, and climatic conditions. The environmental impacts of the use of water from other sources for cooling purposes depend on the source, the amount used, and the ultimate disposition. The different demands for water from the other sources is the subject of water rights and is not covered in this PEIS. This PEIS includes restrictions and mitigations regarding leasing in designated source water protection areas and municipal watersheds or near water bodies, riparian areas, and wetlands. Other restrictions and stipulations apply for special status species and habitats that could include water resources.

These conditions and the potential to impact them vary by location and the proposed development. Prior to making leasing decisions, BLM will assess whether the existing NEPA is adequate (i.e., through completion of a DNA), or whether there is new information or new circumstances that warrant further analysis. Prior to BLM allowing any drilling activities, the lessee will be required to obtain necessary permits from the appropriate state agencies and will be required to isolate and protect groundwater sources from contamination and depletion.

I-2-5

Site-specific impacts on water resources, including groundwater and water importation, would be addressed as part of the environmental analysis for the permitting process. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis. BLM and FS would work with interested and affected parties to identify and resolve resource conflicts. Appropriate site-specific mitigation would be developed as necessary. The use of other water resources to "replenish" the geothermal resource using other sources would be subject to subsequent permit decisions at the state and federal level. Any new action would also have to comply with relevant environmental laws. As discussed in Section 1.5.1, water rights are administered and adjudicated at the state level. Each prospective lessee-developer will be required to apply for and obtain an adjudicated state water right before actually attempting to recover geothermal resources (see Section 1.5.1).

I-2-6

Since the PEIS must include multiple environments, geothermal reservoir, and power production technologies, the language used is meant to be general and encompasses all fluids (water, steam, and mix) except where specified as one type. Text has been added to clarify that most of the power production anticipated to occur is by binary systems followed by flash steam systems. Geothermal resource with potential for dry steam power production, the type discussed in the comment, is very rare. The Geysers is the only such resource in the United States. Other methods will require considerable development before production leasing becomes more common. See also response to comment 1-2-4.

I-2-7

As noted above, the PEIS covers geothermal leasing. Issuance of a lease does not require the lease holder to specify what kind or size of plant would be developed on the lease site; therefore, discussion of alternate technologies is not appropriate in this analysis. All development and utilization and reclamation activities, including impacts of WCTs or ACCs, would be subject to further site-specific permitting and environmental analysis.

I-2-8

Site-specific impacts on water resources, including water importation, would be addressed as part of the environmental analysis for the permitting process. All development, utilization, and reclamation activities, including the use of reclaimed water, would be subject to further site-specific permitting and environmental analysis, including public involvement, as appropriate.

As discussed in Section 1.5.1, water rights are administered and adjudicated at the state level. Each prospective lessee-developer will be required to apply for and obtain an adjudicated state water right before actually attempting to recover geothermal resources (see Section 1.5.1).

I-2-9

See response to comment 1-2-8, above.

I-2-10

As noted above, the PEIS covers geothermal leasing. Issuance of a lease does not require the lease holder to specify what kind or size of plant would be developed on the lease site; therefore, discussion of alternate technologies is not appropriate in this analysis. All development and utilization and reclamation activities would be subject to further site-specific permitting and environmental analysis.

I-2-11

As noted above, issuance of a lease does not require the lease holder to specify what kind or size of plant would be developed on the lease site. Site-specific impacts would be analyzed prior to any development activities for the lease sites.

I-2-12

Temperature is not a resource required to be analyzed under NEPA. No environmental resources requiring analysis under NEPA are expected to be affected by heat release by geothermal plants.

I-2-13

This and all RFD numbers come from the Western Governor Association's Geothermal Task Force Report. We are unable to verify data from each location.

I-2-14

An air-cooled plant would require more land and would be closer to the average 25-acre site, whereas a water-cooled plant would require less land and the total site would be closer to 20 acres.

I-2-15

See responses to comments I-2-4 and I-2-6.

I-2-16

When fluid is extracted from a geothermal resource, the fluid pressure is decreased, increasing the potential for subsidence and compaction. This can result in an increased number of very small earthquakes with little risk for damage. The greater risk is from injection of fluids into a system, resulting in increased pressure and effective "lubrication" of existing faults. This can result in larger earthquakes occurring along the "lubricated" faults.

Reinjection of extracted fluids helps maintain the existing pressures. As long as reinjection does not occur directly into a fault, maintaining the existing pressures does not increase the potential for large earthquakes.

I-2-17

See responses to comments I-2-4 and I-2-6 for discussion of development of high steam areas.

Subsidence also depends on the geological characteristics of the area where the geothermal fluids are extracted, or where any other groundwater source used for cooling may be extracted. These conditions and the potential to impact them vary by location and the proposed development. Prior to making leasing decisions, BLM will assess whether the existing NEPA is adequate (i.e., through completion of a DNA), or whether there is new information or new circumstances that warrant further analysis.

I-2-18

Site-specific impacts on water resources, including water importation, would be addressed as part of the environmental analysis for the permitting process. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis. Appropriate site-specific mitigation would be developed as necessary.

I-2-19

Site-specific impacts on water resources would be addressed as part of the environmental analysis for the permitting process. The PEIS discusses the amount of geothermal fluid lost to the system due to emission of steam and cooling losses. New language has been added to state that the generation of electrical power through geothermal energy requires the use of varying amounts of water from other sources for cooling purposes depending on the technology used, the temperatures involved, and climatic conditions.

In assessing the RFDS, the PEIS discusses the total fluid expected to be extracted per lease (2 wells with up to 5 million gpd). The PEIS also discusses the amount that could be reinjected for closed loop systems (10 million gpd) and flash steam facilities (8 to 8.5 million gpd). Dry steam power plants like The Geysers do not reinject any fluids. However, resources capable of being developed for dry steam power plants are very rare. The Geysers is the only such resource in the United States. Text has been added to the PEIS to discuss the rarity of potential dry steam resources.

I-2-20

As discussed in responses above, issuance of a lease does not require the lease holder to specify what kind or size of plant would be developed on the lease site; therefore, discussion of alternate technologies is not appropriate in this analysis. All plants would require site-specific permitting and environmental analysis prior to development.

I-2-21

As discussed in responses above, prior to leasing, the BLM or FS would collaborate with appropriate state agencies, as the states typically manage and have regulatory authority for water quality, water rights, and wildlife. Site specific impacts on water resources, including groundwater and water importation would be addressed as part of the environmental analysis for the permitting process.

I-2-22

As noted above, site-specific impacts on water resources, including any impacts on groundwater, would be addressed as part of the environmental analysis for the permitting process prior to development or utilization.

I-2-23

Prior to leasing, the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states typically manage and have regulatory authority for water quality, water rights, and wildlife.

Furthermore, all development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis, including analysis of cumulative impacts as appropriate.

I-2-24

Issuance of a lease does not require the lease holder to specify what kind or size of plant would be developed on the lease site; therefore, discussion of alternate technologies is not appropriate in this analysis (see Section 1.11.1, *BLM and FS Decisions to be Made Following Subsequent NEPA Analysis* for further discussion of permitting). All development and utilization and reclamation activities would be subject to further site-specific permitting and environmental analysis, including analysis of water resources and biological resources.

I-2-25

See above response for comment I-2-24.

I-2-26

ACEC data were provided by individual state offices and may not represent a comprehensive list. Geothermal leasing will recognize existing ACECs. Leasing will be prohibited or restricted on ACECs where the BLM determines that geothermal leasing and development would be incompatible with the purposes for which the ACEC was designated or for those whose management plans expressly preclude new leasing or development for oil and gas or geothermal resources.

I-2-27

BMPs included in the PEIS for visual resources are more specific because all BLM and FS lands can be assessed and put into a few specific categories. In contrast, water and biological resources are highly location specific. BMPs for water and other resource in this document are intended to provide BLM and FS offices the flexibility to respond to different local needs. Local staff will consult with local stakeholders and develop BMPs and stipulations that are appropriate for the protection of those resources.

I-2-28

As stated in Section 3.11.1, the state-listed species that occur in the planning area that may be affected by a particular project would be identified in site-specific environmental analysis.

geothermal_eis

From: Mary_Christensen@blm.gov [Mary_Christensen@blm.gov] **Sent:** Thu 6/26/2008 4:15 PM
To: geothermal_eis
Cc:
Subject: Mail forwarded from geothermal_eis@blm.gov
Attachments:

This message has been automatically forwarded from geothermal_eis@blm.gov.

"Theodore M. Seeber" <seebert@aracnet.com>
06/26/2008 05:12 PM

To <geothermal_EIS@blm.gov>
cc
bcc
Subject As I'll be on vacation on the coast for the public meeting

I can only hope that somebody has mentioned the danger of such plants- and the technological solution.

I-3-1

The danger: Pumping out too much water, lowering the pressure on fault lines, thus causing earthquakes.

The solution: heat exchangers and reinjection pumps.

Ted Seeber

Beaverton,OR

I-3-1

As stated in Sections 2.5.1 and 4.3.2, geothermal fluids will be used and then reinjected for near zero net change in fluids. This procedure would represent a low risk for increased seismic activity.

Also see response to comment 1-2-16.

GLITNIR

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Global Sustainable Energy Team
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c/o EMPS, Inc.
182 Howard Street, Ste 110
San Francisco, CA 94105
United States

July 1, 2008

Rf: Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States (PGEIS)

To Whom It May Concern:

Herewith, Glitnir would like to comment on the joint Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States (PGEIS) of the Department of the Interior's Bureau of Land Management and the U.S. Department of Agriculture's U.S. Forest Service.

In the United States, the majority of the land with geothermal potential can be found within the western states. For electrical generation or direct heat applications, about 530 million acres in the 12 western states have the geothermal potential. Roughly half of this land, 248 million acres, are on federal land administered by the US Department of the Interior, Bureau of Land Management (BLM) and by the US Department of Agriculture, the National Forest System (NFS).

For developing geothermal projects on those lands, clear leasing processes, leasing decision and administrative guidance are essential for the much needed increase of geothermal energy development in the United States. The implications of any efforts aimed at improving and speeding up the current processes are not to be underestimated. C-4-1

Glitnir therefore commends the efforts by the Bureau of Land Management and the U.S. Forest Service, to programmatically improve leasing processes for geothermal development on federal land, while at the same time clearly point out the importance to fulfill its role in protecting the environment in the land administered by these two agencies.

Glitnir would like to comment on the main points that are put forward in the PGEIS.

Regarding the "proposed action", we support that statement there is need for clear identification of land open or closed to leasing for geothermal development and clarity about pending lease applications. The efforts for formulizing concrete points of stipulations, best management practices and procedures will provide the consistent guidance needed by the industry. The same applies the amendment of land use plans according to the aforementioned. C-4-2

Glitnir shares the opinion of BLM and NFS for the needs for federal action, namely the push for issuance decision on lease applications, time limits as set for by the EPAct of 2005, the call for clean and renewable energy and the impact that this will have on the U.S., e.g. for energy imports, reducing greenhouse gas emissions.

Regarding PGEIS intending to take lands "off-limit" to leasing, we see a strong need for a concrete explanation to the reasons, as well as the need for concrete discussions about the possible impact and trade-offs regarding the decision to not consider the possible leasing of those lands today or in the future. C-4-3

The PEIS gives three different alternative scenarios, while only Alternative B and C are scenarios of a real improvement. We clearly favor the "proposed action" as lined out in Alternative B, which would legally open the most of the public land administered by BLM and NSF to the possibility of geothermal leasing. The guiding resource management plan as put forward here, would provide for a clear process, which is essential for streamlined geothermal development and the dealings of developers between and with BLM, as well as the NFS. We would favor clearer rules on the possibility for access to national park land in this plan, but support a determination of non-discretionary and discretionary determination as put forward in the document. C-4-4 C-4-5

The "leasing (of) lands near transmission lines" (Alternative C), would limit the development of geothermal energy along these 20-mile corridor too much from our perspective. It might loose out on favorable geothermal resources that would otherwise be of good potential for geothermal power development. C-4-6

With increasing energy prices and demand for clean energy resources, geothermal has one of the largest potential of the renewable energy sources "meeting the increasing energy demand, while reducing reliance on foreign energy imports, reducing greenhouse gas emissions, and improving national security", as put forward by the PEIS. Therefore, we believe that it is of utmost importance to make sure that Alternative B will be considered the only feasible answer to those immediate demands for clean energy in the United States. Alternative C, can only be an emergency alternative should it not be able to get Alternative B through all necessary decision channels. It has to be clear that Alternative A is no alternative at all and cannot be considered as an option for any further development of geothermal energy in the United States. C-4-7

The comprehensive list of stipulations, best management practices and procedures for the land use amendment process and subsequent permitting, can be considered to be very positive, and it will be essential to include any input from all affected industry players. Only if the voices of the industry are heard and their opinions and concerns are taken into consideration, these processes will have the impact that both, BLM and NFS, as well as anyone involved in geothermal energy development, are wishing for with these efforts put forward in the PEIS. C-4-8

The clear advantages of geothermal energy, as described by PEIS and the minimal environmental impact should provide enough incentives to push for the improvement of current land leasing processes for geothermal development on federal land.

We would like to encourage all parties that are indirectly or directly involved in geothermal energy development in the United States to take the opportunity to participate in the open discussions of the public meetings scheduled across the western States in July of this year. It is of utmost importance for the industry to take part in these discussions as they can and will have a big impact on further development of geothermal energy development. Constructive participation will show that the industry supports all efforts aimed at speeding up the development, while at the same time be heard about concerns regarding those efforts.

With kind regards,

On behalf of Glitnir
Árni Magnússon, Managing Director – Glitnir Sustainable Energy

C-4-1

The commentor's support for a programmatic document is noted.

C-4-2

The commentor's support for the proposed alternative and decisions on pending lease applications is noted.

C-4-3

The comment is noted.

C-4-4

The commentor's support for the Proposed Action is noted.

C-4-5

Leasing is not permitted on NPS by non-discretionary determination. In addition, leasing is prohibited on lands where it is determined, based on scientific evidence, that exploration, development, or utilization of the lands, subject to the lease application or nomination, is reasonably likely to result in a significant adverse effect on a significant thermal feature within the National Park System (see Section 2.2.2).

C-4-6

The comment on Alterative C is noted.

C-4-7

The comment is noted. Input from all commentors, including industry, has been considered in the formation of the Final PEIS.

C-4-8

The commentor's preference for Alternative B is noted.

geothermal_eis

To... Mary_Christensen@blm.gov

Cc...

Bcc...

Subject: RE: Mail forwarded from geothermal_eis@blm.gov

Attachments:

From: Mary_Christensen@blm.gov [mailto:Mary_Christensen@blm.gov]
Sent: Sat 7/5/2008 10:27 AM
To: geothermal_eis
Subject: Mail forwarded from geothermal_eis@blm.gov

This message has been automatically forwarded from geothermal_eis@blm.gov.

Dot Sulock <dsulock@unca.edu>
07/05/2008 11:24 AM

To geothermal_EIS@blm.gov
cc
bcc
Subject opening public lands for geothermal is a good idea

Geothermal energy is vastly superior to nuclear or coal and frees us from dependence on foreign oil. We need all the geothermal energy we can get. Support new geothermal exploration on federal lands. I-5-1

Dot Sulock, University of North Carolina at Asheville

I-5-1

Thank you for your comment.

geothermal_eis

From:	Mary_Christensen@blm.gov [Mary_Christensen@blm.gov]	**Sent:**	Tue 7/8/2008 9:16 AM
To:	geothermal_eis		
Cc:			
Subject:	Mail forwarded from geothermal_eis@blm.gov		
Attachments:			

This message has been automatically forwarded from geothermal_eis@blm.gov.

Katie Fite <katie@westernwatersheds.org>
07/08/2008 10:14 AM

To <geothermal_EIS@blm.gov>
cc
bcc
Subject Geothermal EiS comments

July 7, 2008

Geothermal Programmatic EIS
c/o EMPSi
12 Howard Street, Suite 110
San Francisco, CA 94105

e-mail: geothermal_EISblm.gov <mailto:geothermal_EIS@blm.gov>

Dear BLM,

Here are comments o Western Watersheds Project on the geothermal development EIS. We are very concerned that BLM is about to allow near-unfettered access an damage to public lands under the Programmatic Wind EIS (already finalized),the Solar EIS, the Geothermal EIS, and innumerable new energy corridor propsals. The devastating ecological Footprint of all of the foreseeable evelopment under this series of EISs (as well as Oil and Gas leasing and other such activty) on sage-grouse, pygmy rabbit and other important and sensitive species ust be fully examined here. 0-6-1

We are very concerned about the filure of the process to provide a framework for rejection/avoidance of solar development on ecologically 0-6-2 important public lands. A set of specifi criteria must be established for examination of ³appropriate² vs. ³inappropprate² siting.

For example, if a geothermal plant and associated roading, owerlines, impacts to water tables, increased human disturbance, habitat fragmentation and other effects is proposedfor an area with a small and/or declining population of sage-grouse, geotermal facilities/ development should not be allowed to occur on those sits. Pleas establish a framework that clearly allows this to happen. We aso ask that you amend the current Wind EIS as part of this geothermal process t add this environmental safeguard to it. Right now, entirely inapproprate and disastrous development is being proposed under that document in Browns Bench/China Mountain and other areas and project proponents/foreign evelopers are saying ³The Wind EIS says development here is ok². This is EXACTLY the stuation that the geothermal EIS must avoid where it is used to justify/cver destruction of critical sage-grouse and other wildlife habitats.

0-6-3

0-6-4

Thisprocess seems aimed at throwing development of many sensitive areas and vunerable native species populations wide-open. A press release states:

The preferred Alternative in the Draft PEIS considers all public lands andNational Forest System lands with potential for geothermal development available for leasing except those that are withdrawn or administrativel closed to geothermal leasing. The Draft PEIS also evaluates another alternatve based on public input gained during scoping that would limit geotherml leasing for electrical generation to areas near transmission lines². 0-6-5

Man BLM Land Use Plans and Forest Plans are old and outdated, and are not crrent inventories of lands and values. New plans finalized in particular oer the past 8 years of the anti-science Bush administration - whre industry desires have trumped all else can not be viewed as using best Avilable or current science in establishing avoidance areas, special naturalareas, or other sites where geothermal exploration/development or oher energy activity may have devastating impacts.

BLM must also establih a process that examines the relative scarcity of the ecological and natral/recreational values affected by geothermal development and exploratin and other ³renewables² on public lands.

BLM must establish a processthat adequately examines the whole Footprint of disturbances and stresss on ecosystems - and deny geothermal development where a series of overlaping and cumulative threats may be jeopardizing species survival.

Several ew alternatives that establish specific criteria for appropriate vs. iappropriate siting, and framework for establishing ³off-limit² areas where denial of leasing readily occurs must be develope as part of this process. Areas that should be evaluated as off-limits t leasing include: Important areas for sage-grouse, pygmy rabbit, and other rae and declining sagebrush-dependent species; Areas with water tables theatened by aquifer drawdown from mining, Las Vegas or other water export such as the Monoregion; areas threatened by irrigation from shallow or geothermal aquifers
sch as habitats for the Bruneau Hot Springs snail, and other vital landsand

waters.

BLM should also act to reconsider and potentially cancel all he flurry of geothermal leasing that is currently occurring especially in Nevada ad other areas where sage-grouse, pygmy rabbit and other species ae greatly threatened by any increased or new habitat fragmentation and loss as would occur with geothermal leasing, development and infrastructure. It eems BLM has conducted this to try to clear as many projects as possible prioto completion of even the minimal controls that could result from this ES. A full accounting of all leases recently issued or foreseeable must be part of this EIS. O-6-6

An honest and accurate ccounting of springsnails and other aquatic biota jeopardized by geothermal dvelopment and the direct, indirect and cumulative effects of livestoc grazing facilities, ag/irrigation, mine aquifer drawdown, SNWA water ming and export, and other activities must be provided as part of this ES. What are these species? What are there populations? What is occurrig with the aquifer levels? How will additional drawdown affect these speces? O-6-7

How might geothermal water removal affect cooler water aquifes and surface expression?

What is the potential for disrupting surface xpressions and flows from various forms of exploration or development inluding invasive dynamiting, drilling etc.? O-6-8

What potentially hazardous substances might be mixed with water re-injected?

How can industry/BLM be certain that anyre-injection does not disrupt aquifers or surface flow expression in ay way?

As mitigation for any geothermal development, purchase of private lnds, purchase and permanent retirement of public lands grazing permits, an removal of harmful spring ³developments² must be required as a range of mtigation actions. Sada et al. 2001 BLM Technical Bulletin details the dsastrous effects of livestock water developments on springs and seeps onpublic lands in the Interior West. It is thus very appropriate that removaland restoration of these very damaging spring developments and pipelines, couled with removal of the stressor of livestock grazing and trampling disturbnce to spring and seep areas and watersheds, be part of the standardmitigation for geothermal activities on public lands. O-6-9

Please fully examine ow livestock-caused desertification processes may be affecting watershds, and aquifer infiltration (vs. rapid runoff) and slow release of waters. ow does this stress, coupled with geothermal development disturbance, affet ecosystems or natural processes? How do both these stresses affct habitats and populations for important and sensitive species?

How willdevelopment of geothermal energy on private, state or other non-public lans alter or affect the geothermal waters of public lands? Can O-6-10 one mega-geotermal pumping plants lead to rapid and sudden aquifer drawdown? Whereare such activities planned?

How will such geothermal explo and devlopment under this EIS affect the very important public recreational uses associated with public lands hot springs? What sideboards can be placed to liit or prevent losses of these unique and important places?

We are very concrned that geothermal development will be done on remote areas, most of the pwer lost in transmission to urban areas, large corporations will control th development, and the public end up with only desiccated hot springs, furter fragmentation and loss of iortant wildlife habitats with little energy actualy used.

If BLM is indeedto follow sensitive species policies, the ESA, its own claims of Conservation Plans for sage-grouse, then it must place many more limits on developent and places off‹limits to all energy disturbance than it has done so far in a similar EIS process for Wind which is right now alowing disastrous foreseeable development of China Mountain/Brown¹s Bench, Table Mountain on NV UT order, and other areas vital to sage-grouse. Geothermal development, withpowerlines galore and new rding may have similar impacts in some areas and this EIS process must establih a clear and easy path for BLM to evaluate and deny development in sensitive lands. 0-6-11

Pease see the recent Atamian Nevada studies on the effects of the Falcon-Gonder powerline on increasing raven numbers and sage-grouse declines. Mater¹s Thesis, and Five Year and other Progress Reports.

How might stagnant ools or ponds of water resulting from geothermal explo or development promote West Nile virus mosquitoes? Tis represents a migratory bird, sage-grouse and human health risk of much significance. 0-6-12

States have various water laws, allocation proceses, etc. Nearly all are drastically over-allocated. Yet geothermal andother aquifers are not based on state line boundaries. How does this affect the setting, risk and uncertainty wih any geothermal development on public lands? 0-6-13

How will livestock razing potentially be intensified as a result of pools of water and/or electricl lines to pump water associated with geothermal development be used for livestock pipelines nd thus the ecological damage caused or related to geothermal devlopment be intensified? / Under alternatives, no new livestock facilities should be allowed in association wih any rights-of-way/geothermal development. 0-6-14

Please apply the following concrns on the Westwide DOE Corridor, where appropriate, to thi geothermal EIS process as well. This includes all concerns raised fromweed impacts to the inefficiency of remote siting of energy facilities. Te full Footprint of any geothermal development, including in having large tansmission lines built especially for it, must be fully examined and sensitive areas placed off-limits to BOTH geothermaland Energy Corridor activity/authorization. 0-6-15

DOE West-wide Corrido PEIS

Sincerely,

Katie Fite
Biodiversity Director
Western Watersheds Project
PO Box 2863
Boise, ID 83701
208-429-1679

ATTACHMENTS

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O-6-1

Cumulative impacts, including impacts from other renewable energy development, are discussed in Chapter 5. Cumulative impacts on specific lease locations would be addressed in additional NEPA documents, when appropriate.

O-6-2

Addressing solar development is outside of the scope of this document.

O-6-3

Before issuing any leases, the BLM would conduct the necessary reviews to ensure that leasing would be compatible with the local land use plan and with all applicable state and local laws and regulations such as Endangered Species Act and National Historic Preservation Act. As noted in Section 2.2.2, there are a variety of stipulations and BMPs that could be applied to protect sensitive issues and conditions.

O-6-3

Amending the Wind EIS is outside of the scope of this PEIS.

O-6-5

Lands designated as open to leasing are subject to existing laws, regulations, and formal orders. In complying with these laws, regulations, and orders, some of the open lands may not be available for leasing. Chapter 2 explains, under *Procedures Prior to Leasing*, that the BLM and FS would comply with the requirements of the Endangered Species Act, including determining if any listed or proposed threatened or endangered species or critical habitat is present on nominated lease parcels and may be affected by any decision to lease. Chapter 6 of the Final PEIS, in turn, explains that the agencies have determined that the decision to lease has no effect on listed species or critical habitat.

To provide further protection for threatened, endangered, and sensitive species, the BLM will impose an Endangered Species Act stipulation (see Section 2.2.2) on all geothermal leases.

This document supports the amendment of plans to adopt the resource allocations, stipulations, procedures, and relevant BMPs for geothermal leasing, as outlined in the PEIS.

The best available science was used in the development of this document.

O-6-6

This document addresses lease applications pending as of January 1, 2005, as well as future geothermal leasing decisions. Current lease sales follow existing procedures outlined in the no action alternative, which include evaluation on a case-by-case basis, including NEPA documentation when appropriate.

O-6-7

Programmatic analysis of the impacts to fish and wildlife is included in Section 4.10. All development, utilization, and reclamation activities would require further site-specific permits and associated environmental analysis.

O-6-8

Site-specific impacts on water resources, including groundwater and water importation, would be addressed as part of the environmental analysis for the permitting process. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis. BLM and FS would work with interested and affected parties to identify and resolve resource conflicts. Appropriate site-specific mitigation would be developed as necessary.

As discussed in Section 1.5.1, water rights are administered and adjudicated at the state level. Each prospective lessee-developer will be required to apply for and obtain an adjudicated state water right before actually attempting to recover geothermal resources (see Section 1.5.1).

There is no way to ensure that there will be no impacts whatsoever. This PEIS presents the information on the potential impacts to water quality and surface disturbance, as well as recommended restrictions and stipulations (discussed in Sections 4.7 and 4.6) to the decision maker for consideration as part of decision process.

O-6-9

All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis. This document does predict a general level of anticipated future geothermal development in BLM areas that have geothermal potential, but it is not intended to provide full analysis of all phases of development. There are several subsequent stages of decision making necessary to approve geothermal resource development, each with its own environmental compliance requirements, including public involvement, as applicable. This document covers only the land use planning and lease issuance stages.

O-6-10

The resource uses compatible with geothermal use are likely to vary depending on site-specific conditions. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis, including public involvement, as appropriate. BLM and FS would work with interested and affected parties to identify and resolve user or resource conflicts. Appropriate site-specific mitigation would be developed, as necessary.

Prior to leasing, the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states typically manage and have regulatory authority for water quality, water rights, and wildlife. Site-specific impacts on water resources, including groundwater and water importation, would be addressed as part of the environmental analysis for the permitting process.

As discussed in Section 1.5.1, water rights are administered and adjudicated at the state level. Each prospective lessee-developer will be required to apply for and obtain an adjudicated state water right before actually attempting to recover geothermal resources (see Section 1.5.1).

O-6-11

The sensitive species stipulation in Section 2.19 states:

For agency-designated sensitive species (e.g., sage grouse), a lease stipulation (NSO, CSU, or TL) would be imposed for those portions of high value/key/crucial species habitat where other existing measures are inadequate to meet agency management objectives.

The BLM and FS have added a procedure prior to leasing in Chapter 2:

> The authorized officer of the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states manage and typically have regulatory authority for water quality, water rights, and wildlife.

The commentor did not provide enough information to locate suggested references.

O-6-12

This document covers only the land use planning and lease issuance stage. All development, utilization, and reclamation activities, including the use of holding pools, would be subject to further site-specific permitting and environmental analysis, including analysis of the impacts to fish and wildlife and human health and safety.

O-6-13

As discussed in Section 1.5.1, water rights are administered and adjudicated at the state level. Each prospective lessee-developer will be required to apply for and obtain an adjudicated state water right before actually attempting to recover geothermal resources (see Section 1.5.1).

O-6-14

All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis. This document does predict a general level of anticipated future geothermal development in BLM areas that have geothermal potential, but it is not intended to provide full analysis of all phases of development. There are several subsequent stages of decision making necessary to approve geothermal resource development, each with its own environmental compliance requirements, including public involvement, as applicable. This document covers only the land use planning and lease issuance stages.

O-6-15

Attachments, including comments for the west-wide corridor EIS, were reviewed and incorporated into revision when appropriate.

MONTANA HISTORICAL SOCIETY

225 North Roberts ✣ P.O. Box 201201 ✣ Helena, MT 59620-1201
✣ (406) 444-2694 ✣ FAX (406) 444-2696 ✣ www.montanahistoricalsociety.org ✣

Tuesday, July 08, 2008

DRAFT GEOTHERMAL LEASING PEIS
C/O EMPSI
182 HOWARD STREET SUITE 110
SAN FRANCISCO CA 94105-1611

RE: Comments *draft* Programmatic EIS for Geothermal Leasing in the Western US

Dear EIS Team:

Thank you for providing us an opportunity to comment on the *draft* Geothermal Leasing PEIS. As is the case with all such programmatic analysis the document is very broad and many resource sections so general so as to hamper effective assessment of effects to those very resources. That is the case here with the cultural resources sections. That lack of specificity has traditionally been accepted for review, at least for cultural resources, since no specific sites could be identified for specific actions/effects at this date. 0-7-1

Rather, general possibilities are dealt with in leasing situations with standard No Surface Occupancy/No Ground Disturbance Stipulations (NSO/NGD) casually referred to in the EIS and attached in leases as standard procedural requirements to be reviewed on a case by case basis during the much later Application for Permission to Drill. This generic programmatic approach is taken in this draft PEIS (see 4-109). The implication being that section 106 of the National Historic Preservation Act may be deferred until specific places and actions are known and that potential effects would then be avoided by NSO/NGD stipulations.

For many readers this may seem to be reasonable given the decision to be made is so broad, in fact vast in scope and breath.

However there are serious pitfalls recognized in the courts for taking this position. In particular, leases have been found to be undertakings requiring reasonable consideration of cultural resources (Historic Properties) under the National Historic Preservation Act (NHPA) prior to a decision which might adversely affect such places if they are later found to exist in a project area leased under an EIS Record of Decision. Most recently the Ninth Circuit Court in Pit River et. al. v. USFS et. al. (No. 04-15746, D.C. No. CV - 02-01314-DFL Opinion) affirmed yet again the necessity of a more effective procedure including cultural resource considerations prior to issuing decisions resulting in irreversible and irretrievable commitments of federal lands to proponents with, in this case, rights to drill which can not or will not be denied. Real and effective federal agency discretion in allowing or permitting or denying an action must remain after the decision (even a general "programmatic" decision) is issued in the Record of Decision (ROD) if specific avoidance of effects to significant places are proposed to be delayed until after the decision to approve the lease is made, and before potential specific cultural resources are identified and considered under section 106 (NHPA).

We recommend that the Ninth Circuit Court findings and published opinion be included in the analysis here. NSO/NGD stipulations have all too often been found to be ineffective tools in avoiding adverse effects for certain kinds of cultural places (such as Traditional Cultural Places -National Register Bulletin 38) or where the boundaries of the lease are constrained by ownership, other resource concerns or even simple topography. In such cases agencies should have, in order to effectively use the NSO/NGD stipulations, the right or authority to preclude disturbance (drilling) altogether (see above Opinion page 18209). As argued elsewhere (e.g. USDI Office of Hearings and Appeals Board of Land Appeals, Mandan, Hidatsa and Arikara Nation v. Marty Ott, BLM 08/18/2004, page 15) BLM statements that it can address and mitigate effects after a lease issuance are contrary to BLM interpretations of its own regulations at 43 CFR §3101.1-2.

Further, "The agencies have consistently interpreted this lease language as a grant [to Calpine] of an absolute right to develop (Pit River v. USFS Ibid page 18210)." The vested rights of lease holders in other words trump the standard stipulations otherwise protecting cultural resources as agencies claim and proceed as though they have no discretion to deny an Application for Permission to drill. 0-7-2

That being the case, the *draft* PEIS could easily be seen as misrepresenting the "protective" stipulations or at the very least not including reasonable disclosures of the potential problems with the basic procedural assumptions and claims built into the EIS and any leases sold under the ROD.

Sincerely,

Stan Wilmoth

Stan Wilmoth, Ph.D.
State Archaeologist/Deputy, SHPO

O-7-1

The PEIS provides multiple levels of protection for cultural resources.

The cultural resource stipulation states that the BLM "may require modification to exploration or development proposals to protect such properties, or disapprove any activity that is likely to result in adverse affects that cannot be successfully avoided minimized or mitigated" (see Section 2.2.2 *Cultural Resource Stipulations)*.

In addition, as stated in the PEIS Section 2.2.2 *Procedures Prior to Leasing*, the authorized officer for the BLM or FS will consult with Native American Tribal governments, Alaska Natives, and State Historic Preservation Officers. Through consultation, the agencies would identify tribal interests and traditional cultural resources or properties that may be affected by the federal leases and potential for geothermal energy development and the presence of archaeological sites and historic properties per Section 106 of the National Historic Preservation Act.

O-7-2

In the PEIS, additional protections exist for cultural resources beyond the standard lease stipulations.

As stated in the PEIS Section 2.2.2 *Procedures Prior to Leasing*, the authorized officer for the BLM or FS will consult with Native American Tribal governments, Alaska Natives, and State Historic Preservation Officers. Through consultation, the agencies would identify tribal interests and traditional cultural resources or properties that may be affected by the federal leases and potential for geothermal energy development and the presence of archaeological sites and historic properties per Section 106 of the National Historic Preservation Act.

Bureau of Land Management and Forest Service
Geothermal Leasing in the Western United States Draft PEIS

We encourage you to provide your comments by filling out and submitting this comment form **by *September 19th, 2008.*** Please fax your completed form to 1-866-625-0707 or mail it to the address on the opposite side. You are also welcome to e-mail your comments to: geothermal_eis@blm.gov

Your Name Virginia Gillerman Date 7-21-2008

Mailing Address 2974 E. Hard Rock Dr. City/State/Zip Boise, ID 83712

Telephone (optional) 208-861-8184 E-Mail Address (optional) vgillerm@uidaho.edu

Would you like to be added to this project's mailing list to receive future project-related information?

Yes ☒ No ☐

Please indicate your affiliation by checking **one** of the following boxes:

☒ Individual (no affiliation) ☐ Private Organization ☐ Citizen's Group

☒ Federal, State, or Local Government ☐ Elected Representative ☐ Regulatory Agency

Name of organization, government, group, or agency (if applicable) (Idaho Geological Survey)

The BLM and FS want to hear from you! Please provide your comments on the Draft PEIS in the space below.

It is a great idea to facilitate geothermal energy development - clean power & heat. You should keep open to leasing the maximum acreage. Also P-DEIS is good way to assist regulators move lease applications through the process quickly. I-8-1

One complaint I have heard is that some private developers wish way to protect their ideas from competitors with more $. Either BLM/FS should nominate parcels or companies should have right to submit counteroffer (first refusal etc.) after higher bid. I-8-2

Also — over

(Continue your comments on the other side)

If you wish to withhold your name or address from public review or from disclosure under the Freedom of Information Act, you must state this prominently in your comments. Such requests will be honored to the extent allowed by law. All submissions from organizations or businesses, and from individuals identifying themselves as representatives of organizations or businesses, will be made available for public inspection in their entirety

To speed things along –
reduce duplication of second
EIS to only look at site-specific issues
and use PEIS and other general regs any
BMPs to help local district BLM/FS
staff swiftly and with minimal cost
write EIS for drill/proposed geothermal
project.

I-8-3

(Please fold this sheet in half & tape shut before mailing – Do not staple)

Place
First Class
Stamp
Here

Geothermal Programmatic EIS
c/o EMPSi*
3775 Iris Ave. Suite 1A
Boulder, Co 80301

*Acting as a contracted agent
for the Bureau of Land Management
and Forest Service*

I-8-1

The commentor's support for geothermal development is noted.

I-8-2

Leasing for indirect use will continue to operate on the current competitive lease sale basis, as described in Section 1.5.3.

I-8-3

It is the intention of the BLM that the PEIS amend affected land use plans by allocating BLM lands as open or closed to geothermal leasing and by identifying appropriate stipulations and BMPs. Subsequent environmental analysis would be focused on site-specific impacts for geothermal exploration, drilling, utilization, and reclamation. Any additional NEPA documents could tier to this document in accordance with NEPA implementation regulations (Section 1.9.1).

Bureau of Land Management and Forest Service
Geothermal Leasing in the Western United States Draft PEIS

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Your Name KATIE FITE Date 7/21/08
Mailing Address WESTERN WATERSHEDS PROJECT City/State/Zip PO BOX 2863 BOISE ID 83701
Telephone (optional) 429-1679 E-Mail Address (optional)

Would you like to be added to this project's mailing list to receive future project-related information?
Yes ☒ No ☐

Please indicate your affiliation by checking **one** of the following boxes:
☐ Individual (no affiliation) ☐ Private Organization ☒ ~~Citizen's~~ Group
☐ Federal, State, or Local Government ☐ Elected Representative ☐ Regulatory Agency

Name of organization, government, group, or agency (if applicable)

The BLM and FS want to hear from you! Please provide your comments on the Draft PEIS in the space below.

DEAR BLM - PLEASE
-REQUIRE BURYING ALL LINES TO SITES TO REDUCE SAGE GROUSE, PYGMY RABBIT, OTHER IMPACT ~~[illegible]~~ AND INCLUDING MIGRATORY + RESIDENT BIRD COLLISIONS. 0-9-1

-NO NET INCREASE WITH ROADS WITH ANY PUBLIC LANDS PROJECT 0-9-2

- EXPAND NO GEOTHERMAL DEVELOPMENT ZONES TO KEY SAGE-GROUSE, PYGMY RABBIT + OTHER SENSITIVE SPECIES LANDS, + BLM WILDERNESS-SUITABLE LANDS + FOREST ROADLESS, 0-9-3

(Continue your comments on the other side)

If you wish to withhold your name or address from public review or from disclosure under the Freedom of Information Act, you must state this prominently in your comments. Such requests will be honored to the extent allowed by law. All submissions from organizations or businesses, and from individuals identifying themselves as representatives of organizations or businesses, will be made available for public inspection in their entirety

O-9-1

The scope of this PEIS is to allocate geothermal resources and apply stipulations for leasing on BLM and FS lands with geothermal potential (Section 1.9). Transmission line siting is not determined in this document.

O-9-2

Site-specific impacts for subsequent geothermal exploration, drilling, utilization, and reclamation, including roads, would be addressed during the permitting process in separate NEPA documents.

O-9-3

Before issuing any leases, the BLM would conduct the necessary review to ensure that leasing would be compatible with the local land use plans and site-specific resources. As noted in Section 2.2.2, there are a variety of stipulations and BMPs that could be applied to protect sensitive issues and conditions.

BLM Wilderness Areas are included under Section 2.2.2 as Congressionally designated lands that are likely to be closed to leasing.

The existing case law regarding the roadless rule is inconsistent. On August 12, 2008, the Wyoming District Court found the 2001 Roadless Rule violated NEPA and the Wilderness Act. *State of Wyoming v. U.S. Dept. of Agriculture,* 07-CV-17-B, Wyoming District Court, Cheyenne, Wyoming [2008]). The District Court ordered the 2001 Roadless rule "set aside" and "permanently enjoined." This Order is subsequent to a 2006 California District Court ruling that set aside the 2005 State Petitions Rule and reinstated the 2001 Roadless Rule. See *California ex re. Lockyer v. U.S. Dept to Agriculture*, 459 F.Supp.2d 874 (N.D. Cal 2006).The United States Justice Department, on behalf of the Department of Agriculture, has filed motions with both the Wyoming and California courts seeking adjustments of those courts' conflicting judicial orders. Neither the Wyoming nor California District Court rulings bar the Department of Agriculture from promulgating other roadless area regulations. To address this inconsistency, the PEIS includes the following Department of Agriculture Roadless Area Stipulation, "If future legislation or regulations change the roadless area designation, the restriction would be revised along with any appropriate environmental review." An appropriate NEPA review would be required prior to any changes to the Roadless Area Stipulation.

Follow up

geothermal_eis

From: Mary_Christensen@blm.gov [Mary_Christensen@blm.gov] **Sent:** Mon 7/21/2008 1:54 PM
To: geothermal_eis
Cc:
Subject: Mail forwarded from geothermal_eis@blm.gov
Attachments:

This message has been automatically forwarded from geothermal_eis@blm.gov.

Mattson McDonald
<matmcd2002@yahoo
.com>

07/21/2008 02:51
PM

Please respond to
matmcd2002@yahoo.
com

To
geothermal_EIS@blm.gov
cc

bcc

Subject
Support for Geothermal energy
production

Dear BLM project Managers,
I have read the draft on Geothermal leasing of BLM lands for energy production and support it very strongly. Energy independance is a national priority now. Please keep me posted an developments. I-10-1
Pamela Mattson Mc Donald

I-10-1

Thank you for you comment.

Bureau of Land Management and Forest Service
Geothermal Leasing in the Western United States Draft PEIS

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Your Name Morty Prisament Date

Mailing Address Tetra Tech 3380 Americana Terrace City/State/Zip Ste. 201 Boise 83706

Telephone (optional) 208 4892840 E-Mail Address (optional) monty.prisament@ttemi.com

Would you like to be added to this project's mailing list to receive future project-related information?

Yes ☒ No ☐

Please indicate your affiliation by checking **one** of the following boxes:

☐ Individual (no affiliation) ☒ Private Organization ☐ Citizen's Group

☐ Federal, State, or Local Government ☐ Elected Representative ☐ Regulatory Agency

Name of organization, government, group, or agency (if applicable) Tetra Tech

The BLM and FS want to hear from you! Please provide your comments on the Draft PEIS in the space below.

Have not yet reviewed the P-DEIR but appreciate opportunity to attend tonights meeting in Boise. C-11-1

(Continue your comments on the other side)

If you wish to withhold your name or address from public review or from disclosure under the Freedom of Information Act, you must state this prominently in your comments. Such requests will be honored to the extent allowed by law. All submissions from organizations or businesses, and from individuals identifying themselves as representatives of organizations or businesses, will be made available for public inspection in their entirety

C-11-1

Thank you for your comment.

geothermal_eis

From: Mary_Christensen@blm.gov [Mary_Christensen@blm.gov] **Sent:** Tue 7/22/2008 5:18 PM
To: geothermal_eis
Cc:
Subject: Mail forwarded from geothermal_eis@blm.gov
Attachments:

This message has been automatically forwarded from geothermal_eis@blm.gov.

"Phil Ronnerud" <pronnerud@co.greenlee.az.us>

07/22/2008 06:15 PM

To <geothermal_EIS@blm.gov>

cc

bcc

Subject Comments

Although leasing will be subject to existing laws, regulations, formal orders, stipulations, etc., these documents are insufficient if the people doing the development do not care.

Development of geothermal and other energy resources, e.g. solar and wind, requires onsite, and offsite, infrastructure. That infrastructure maintenance is stopped or the local entities are expected to do the work after project ends. Local entities cannot afford the costs. Development and maintenance of the infrastructure and restoration of the land must be paid by the developer. They should not be able to walk away from any work done without complete restoration. Because of the fragile nature land restoration is not a one time line item. Restoration is a continuous and long term process that has many facets. New techniques need to be developed to help better accomplish the goals. A-12-1

Scarring of the land from construction disturbance must be considered. Old mines, power lines, and roads leave marks that last for years and over the years can lead to significant local degradation of the land. Witness the A-12-2 visible marks and erosion from power lines and natural gas lines on aerial photographs. These disturbances then become the sources of sediment and pathways for continued use by other parties.

Costs go beyond direct facilities. Long term land use change as new roads are developed and land becomes easier to access. Traditional land uses change, or is displaced, as new faces arrive at, then leave, the area. Any traditional land uses must be respected. These folks, ranchers and other land resource users, have an interest in the land. Their voices often are not heard or discounted. A-12-3

These changes then lead to indirect cost for governmental agencies. School districts lose their traditional tax base while new develop. Often the revenue is not replaced. New workers come into communities and expect different services. Law enforcement has new territory to consider.

If a facility will be long term installation then multiple use for the infrastructure, roads and access ways, should be considered. Trails and off road access ways are badly needed for recreation. Design and construction of the facilities should consider and be available all the land users.

Before transporting the energy long distances, local agencies should have the option for use. This local use could help eliminate some of the land use infrastructure issues.

Regards

Philip Ronnerud

Planning and Zoning Director

GreenleeCounty

P.O. Box908

Clifton, Arizona 85533

928 865 4762 voice

A-12-1

Comment noted. This PEIS covers the leasing phase of geothermal development. See Section 2.5 for a discussion of phases of leasing and development. BLM's new geothermal regulations include strict bonding and reclamation requirements. See 43 CFR Part 3200.

A-12-2

All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis. This document does predict a general level of anticipated future geothermal development in BLM areas that have geothermal potential, but it is not intended to provide full analysis of all phases of development. There are several subsequent stages of decision making necessary to approve geothermal resource development, each with its own environmental compliance requirements. This document covers only the land use planning and lease issuance stages.

A-12-3

The comment is noted. As discussed in the above response, there are several subsequent stages of decision making necessary to approve geothermal resource development, each with its own environmental compliance requirements, including public input, as applicable. This document covers only the land use planning and lease issuance stages.

Bureau of Land Management and Forest Service
Geothermal Leasing in the Western United States Draft PEIS

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Your Name KIM NIGGEMANN Date JULY 22, 2008
Mailing Address 900-409 GRANVILLE ST., City/State/Zip VANCOUVER, BC V6N 2V8
Telephone (optional) 1-866-688-0808 E-Mail Address (optional) kniggemann@nevadageothermal.com
Would you like to be added to this project's mailing list to receive future project-related information?
Yes ☑ No ☐
Please indicate your affiliation by checking **one** of the following boxes:
☐ Individual (no affiliation) ☑ Private Organization ☐ Citizen's Group
☐ Federal, State, or Local Government ☐ Elected Representative ☐ Regulatory Agency
Name of organization, government, group, or agency (if applicable)__________________

The BLM and FS want to hear from you! Please provide your comments on the Draft PEIS in the space below.

Our concern is what happens when the PEIS does not cover the areas that we wish to conduct exploration (drilling) work on? What kind of a timetable will the BLM field offices be held to? Do we have any guarantee that any additional work required by the BLM will be completed in a reasonable amount of time and expense? O-13-1

(Continue your comments on the other side)

If you wish to withhold your name or address from public review or from disclosure under the Freedom of Information Act, you must state this prominently in your comments. Such requests will be honored to the extent allowed by law. All submissions from organizations or businesses, and from individuals identifying themselves as representatives of organizations or businesses, will be made available for public inspection in their entirety

O-13-1

Areas not contained within the geothermal potential area are not closed to leasing. These areas will follow the existing procedures for leasing outlined in Alternative A.

Bureau of Land Management and Forest Service
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Your Name CHIP MANSURE Date 7/22/8
Mailing Address 11000 RICHFIELD AVE NE City/State/Zip ALBUQUERQUE, NM 87122
Telephone (optional) 505-844-9315 E-Mail Address (optional) AJMANSU@SANDIA.GOV
Would you like to be added to this project's mailing list to receive future project-related information?
Yes ☐ No ☒
Please indicate your affiliation by checking **one** of the following boxes:
☒ Individual (no affiliation) ☐ Private Organization ☐ Citizen's Group
☐ Federal, State, or Local Government ☐ Elected Representative ☐ Regulatory Agency

Name of organization, government, group, or agency (if applicable)________________

The BLM and FS want to hear from you! Please provide your comments on the Draft PEIS in the space below.

THE APPROACH OF SEPARATE PROGRAMITIC AND INDIVUAL LEASE ACTIONS, AND ALSO, TOP LEVEL GUIDANCE/ AMENDMENTS IMPLEMENTED/SUPERCEDED BY LOCAL DECISION MAKING IS THE RIGHT/BEST APPROACH.

NO ACTION WOULD BE IRRISPONSIBLE GIVEN THE IMPORTANCE/NEED FOR ENERGY AND CLIMATE ISSUES. I-14-1

RESTRICTING ACTION TO CORRIDORS OVERLOOKS THE NEEDS OF LOCAL AREAS AND WOULD NOT LEAD TO THE BEST DECISONS AND USE OF BLM & FS PERSONEL/ RESOURCES WHEN ACTION OUTSIDE OF CORRIDORS IS NEED.

PROPOSED ACTION IS CORRECT ONE. **(Continue your comments on the other side)**

If you wish to withhold your name or address from public review or from disclosure under the Freedom of Information Act, you must state this prominently in your comments. Such requests will be honored to the extent allowed by law. All submissions from organizations or businesses, and from individuals identifying themselves as representatives of organizations or businesses, will be made available for public inspection in their entirety

I-14-1

Thank you for your comment. The commentor's preference for the Proposed Action is noted.

geothermal_eis

From: Mary_Christensen@blm.gov [Mary_Christensen@blm.gov] **Sent:** Mon 7/28/2008 6:57 PM
To: geothermal_eis
Cc:
Subject: Mail forwarded from geothermal_eis@blm.gov
Attachments:

This message has been automatically forwarded from geothermal_eis@blm.gov.

"Patrick Sullivan" <psullivan32@cox.net>

07/28/2008 08:11 PM

To <geothermal_eis@blm.gov>

cc

bcc

Subject Comments on the Western Geothermal Draft PEIS

Hello!

I have reviewed much of the Western Geothermal Draft PEIS, and I would like to submit the following comments:

The proposed action laid out in the Programmatic Analysis of volume 1 best meets the demonstrated needs and follows necessary guidelines. I-15-1

I encourage clarification of the discretionary closure of "Military reservations where geothermal development would conflict with the military mission" (p. 2-7) to specifically confirm that such military reservations are open for development except in instances when a specific conflict with the mission is identified by the military. I-15-2

The proposed actions identified in Chapter 12 (El Centro Field Office leases) does a thorough job of documenting the proposal's success in meeting demonstrated needs without excessive negative environmental impacts. I-15-3

Please include data on the Angeles National Forest, California, in Table K-2, Appendix K, page K-3. I-15-4

Thanks for your time and hard work! Enjoy the rest of the summer!

Sincerely,

Patrick Sullivan
psullivan32@cox.net

I-15-1

Thank you for your comment. The commentor's preference for the Proposed Action is noted.

I-15-2

Thank you for your comment. Language in the Final PEIS has been clarified as suggested.

I-15-3

Thank you for your comment.

I-15-4

Thank you for your comment. The table has been modified as suggested.

GEOTHERMAL ENERGY ASSOCIATION

209 Pennsylvania Avenue SE, Washington, D.C. 20003 U.S.A.
Phone: (202) 454-5261 Fax: (202) 454-5265 Web Site: www.geo-energy.org

July 30, 2008

Dear Bureau of Land Management and US Forest Service,

These comments are submitted on behalf of the Geothermal Energy Association to support the initiative of the Bureau of Land Management and the US Forest Service to develop a Programmatic Environmental Impact Statement for Geothermal Leasing. We applaud the agencies for completing the draft PGEIS, and encourage expeditious completion of this document and necessary subsequent actions to allow geothermal leasing and development.

The development of geothermal energy resources has never been more important. Without access to multiple-use public lands, geothermal energy development for both electric power and direct uses will be curtailed. Today about one-half of the geothermal power production in the US involves use of federal lands and it would be reasonable to assume that at least one-half of future geothermal energy production in the West will depend upon federal leases. The problem in many areas is simply that without adequate environmental analysis and land-use planning, federal agencies cannot make timely and appropriate decisions on geothermal leasing and permitting. This is a critical problem which this PGEIS seeks to address. C-16-1

NEPA and the PGEIS in Context of Global Warming

The Draft PGEIS that has been released is important for both geothermal development and public land management. In the light of recent scientific reports, it is now clear that global warming is one of the greatest threats to the natural resources, wildlife, and other environmental qualities of both BLM and FS lands. (*See*: Preliminary review of adaptation options for climate-sensitive ecosystems and resources, Final Report, Synthesis and Assessment Product 4.4 June 2008, A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. [Julius, S.H., J.M. West (eds.), J.S. Baron, L.A. Joyce, P. Kareiva, B.D. Keller, M.A. Palmer, C.H. Peterson, and J.M. Scott (Authors)]. U.S. Environmental Protection Agency, Washington, DC, USA). According to this as well as other reports a wide range of impacts is being seen already and even more are expected in the future that seriously impact public lands and resources – from increased fires, insect outbreaks, tree mortality, and species extinction. C-16-2

As a result, BLM and the Forest Service should consider, as directed by the National Environmental Policy Act, that development of geothermal energy as an environmental positive use of the public lands supports their future management and sustainability.

Title I of the National Environmental Policy Act (NEPA) contains a Declaration of National Environmental Policy which requires the federal government to use all practicable means to create and maintain conditions under which man and nature can exist in productive harmony. Section 102 requires federal agencies to incorporate environmental considerations in their planning and decision-making through a systematic interdisciplinary approach. Specifically, all federal agencies are to prepare detailed statements assessing the environmental impact of and alternatives to major federal actions significantly affecting the environment. These statements are commonly referred to as environmental impact statements (EISs). Section 102 also requires federal agencies to lend appropriate support to initiatives and programs designed to anticipate and prevent a decline in the quality of mankind's world environment.

Alternatives Considered

Given the context discussed above, it should be clear that the proposed action (Alternative B) is the best alternative, and that both the "no action" alternative (Alternative A) and the "limited leasing" alternative (Alternative C: Leasing Lands Near Transmission Lines) are not acceptable courses of action.

Alternative C is seriously flawed, and could create even more problems that it solves. First, existing transmission lines may lack adequate capacity, and the proposal ignores RETI, WGA and other transmission planning processes. Moreover, transmission lines are primarily an issue of economics for any particular project or area. As a result adopting this alternative would be inappropriately imposing BLM's judgment about project economics in a wholly unsupportable manner. C-16-3

Power Generation Assumptions

The PGEIS considers geothermal resources in Montana and Wyoming to be viable only for direct uses (heating), which is not correct. It is important that the PGEIS consider that there may be geothermal resources on federal lands in these states that would be viable for power production. The temperature threshold for competitive electric power production is much lower than it was just a few years ago. The PGIES should recognize the potential for electrical power production in all of the states being examined. C-16-4

PGEIS Decision Implementation

We are concerned that the PGEIS may not achieve its goal of expediting geothermal projects if the federal agencies do not make a clear commitment to follow through with appropriate land-use plan amendments for both FS and BLM lands.

While the BLM has identified the land use plans it proposes to amend if the proposed alternative is adopted, the PGEIS indicates that the Forest Service follows a different process. While the BLM-FS Memorandum of Understanding (MOU) provides some insight into what this process may be, it is not clearly defined in the PGEIS, and there appears to be no clear plan of action laid out for ensuring that this is accomplished. The final document should include a specific plan of action for both FS and BLM lands, which includes specific timelines for implementing the decisions of the PGEIS on the public lands administered by both agencies. C-16-5

Proposed Restrictions

We are also concerned that Alternative B in the PGEIS would restrict geothermal development of public lands in ways that are neither necessary nor desirable. For example, the draft PGEIS seems to assume *a priori* that lands closed to fluid mineral development should also be closed to geothermal projects (at least for ACECs). Applying the same standards to fossil fuel development and renewable geothermal development is inconsistent and fails to consider the environmental benefits of geothermal energy. C-16-6

Given the fact that climate change is such a severe threat to public lands, and that geothermal development helps address this threat, BLM should provide information to adequately explain the impact of the different statutory or administrative rationales for closing lands to leasing. Moreover, the BLM should examine whether subsequent land-use plan amendments should specifically be required to maintain access to public lands for geothermal energy development in light of the positive role geothermal energy plays in supporting the protection of public lands and resources.

Since NEPA seeks to inform decision makers about the potential impact upon the environment of their actions, we would urge the BLM and the FS to consider whether any of the current restrictions or uses of the public lands which may create obstacles to geothermal development will also result directly or indirectly in increased global warming. For example, off-road vehicle use, grazing, and motorized recreation all create direct impacts upon the environment and add to global warming. Other alternative land uses, such as the creation of new recreation areas, can add indirectly to global warming by promoting more use of motor vehicles. C-16-7

If restricting geothermal use of an area results in not just less geothermal energy production but also permits and even promotes other uses that contribute to climate change, this should be made clear in this analysis. Also, the agencies should consider whether, in such cases, there are criteria that should be developed that trigger reconsideration of such decisions in the PGEIS process, subsequent land-use planning amendments, or elsewhere. It is simply unfair and acting in contravention of NEPA to systematically treat the status quo or the "no action" alternative as environmentally preferable, given the overarching impact of global warming and the importance of geothermal energy to addressing this threat.

Conclusion

Thank you for the opportunity to present these comments. We urge the BLM and Forest Service to move forward expeditiously with the PEIS in the full spirit of NEPA. As Section 2 of the National Environmental Policy Act of 1969, Public Law 91-190, states:

"The purposes of this Act are: To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will present or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality."

These words takes on new meaning as we face unparalleled challenges to our nation and its environment, challenges that are rooted in our use of unsustainable energy resources and which can and should be addressed by expanding our use of our nation's vast and largely untapped renewable energy resources, particularly geothermal energy.

Sincerely,

Karl Gawell
Executive Director

C-16-1

Thank you for your comment.

C-16-2

The Final PEIS has been modified to include additional climate change discussion for affected resources. Please see the water, soil, vegetation, fish and wildlife, and other resource sections in the Final PEIS.

The commentor's preference for the Proposed Action (Alternative B) is noted.

C-16-3

The comment is noted.

C-16-4

Reasonably Foreseeable Development Scenarios have been added for Montana and Wyoming at levels of 20 MW by 2015 and 50 MW by 2025 for each state. No data were available for these states, but the parallel to Colorado was drawn due to the similarity in resource base across the Rocky Mountain Region.

C-16-5

For the FS, this PEIS expedites geothermal projects by identifying those lands that are legally open or closed to consideration for geothermal leasing on affected NFS lands, along with any terms and conditions. The PEIS also describes Reasonably Foreseeable Development Scenarios for various stages and types of geothermal exploration and development. The FS would be able to tier from the PEIS, and the information in the PEIS would facilitate future leasing analysis and any allocation or stipulation decisions. For any leasing on NFS lands beyond the specific pending lease applications discussed in Volume II, the FS would still need to provide consent. Prior to providing consent to the BLM, the FS generally must identify specific lands that are administratively available for leasing of geothermal resources and under what conditions. In order to make the administrative availability decision, the FS generally must prepare an additional NEPA document (leasing analysis). The FS is not proposing to amend any land use plans as part of the proposed action. Decisions resulting from this PEIS for both agencies are outlined in Section 1.11.

C-16-6

As discussed in Section 2.2.1, areas that require protection from the development of fluid resources are likely to require protection from similar effects from the development of geothermal resources. The BLM has therefore determined that for ACECs, the management approach to development of oil and gas resources may appropriately serve as a surrogate for development of geothermal resources, absent more explicit geothermal-specific treatment.

Rationale for closure of lands is detailed in Section 2.2.1.

The BLM recognizes the benefits of geothermal energy, particularly in respect to climate change. The purpose of the PEIS is to allow geothermal leasing, while providing protection for other resource uses.

C-16-7

The BLM and the FS agree that it is important to facilitate the development of geothermal resources. As explained in Section 4.8, the development of geothermal resources for energy production is likely to offset greenhouse gas emissions that result from traditional fossil fuel methods of energy production. In this respect, the action alternatives appear to be environmentally preferable.

The resource uses compatible with geothermal use are likely to vary depending on site-specific conditions. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis, including public involvement, as appropriate. BLM and FS would work with interested and affected parties to identify and resolve resource conflicts. Appropriate site-specific mitigation would be developed as necessary.

An in-depth analysis of the greenhouse gas emission impacts of each and every land use that the BLM and FS currently oversee is beyond the scope of this analysis.

Bureau of Land Management and Forest Service
Geothermal Leasing in the Western United States Draft PEIS

We encourage you to provide your comments by filling out and submitting this comment form ***by September 19th, 2008.*** Please fax your completed form to 1-866-625-0707 or mail it to the address on the opposite side. You are also welcome to e-mail your comments to: geothermal_eis@blm.gov

Your Name JAMES LOVEKIN Date 30 JULY 2008

Mailing Address GeothermEx, 5221 CENTRAL AVE SUITE 201 City/State/Zip RICHMOND CA 94804

Telephone (optional) (510) 527-9876 E-Mail Address (optional) jimlovekin@geothermex.com

Would you like to be added to this project's mailing list to receive future project-related information?
Yes ☑ No ☐

Please indicate your affiliation by checking **one** of the following boxes:
☐ Individual (no affiliation) ☑ Private Organization ☐ Citizen's Group
☐ Federal, State, or Local Government ☐ Elected Representative ☐ Regulatory Agency

Name of organization, government, group, or agency (if applicable) GeothermEx, Inc.

The BLM and FS want to hear from you! Please provide your comments on the Draft PEIS in the space below.

THE AREA OF GEOTHERMAL POTENTIAL SHOULD INCLUDE THE SAN FRANCISCO VOLCANIC COMPLEX IN NORTH CENTRAL ARIZONA. C-17-1

(Continue your comments on the other side)

If you wish to withhold your name or address from public review or from disclosure under the Freedom of Information Act, you must state this prominently in your comments. Such requests will be honored to the extent allowed by law. All submissions from organizations or businesses, and from individuals identifying themselves as representatives of organizations or businesses, will be made available for public inspection in their entirety

C-17-1

As discussed in Section 1.6, *Areas with Geothermal Potential*, the geothermal potential area used to delineate the planning area for the PEIS was developed in a collaborative manner with Federal and state agencies, universities, industries, research organizations, and experts in the field based on areas with a reasonable likelihood for geothermal development activity in the near future.

Geothermal PEIS Public Hearing
Helena, Montana
Louis and Clark Library
July 23, 2008

Oral Comment:
Deborah Hayden- Swiftcurrent Ventures

What happens when other geothermal resources are discovered but are not on this map but are on BLM or FS land. Particularly in the Sweetgrass Hills in Tule County up by the Canadian border, there are volcanic extrusions where the federal government owns the top of mountains (7,000 feet high), but it has not been identified on any of the geothermal potential maps. I-18-1

I-18-1

Areas not contained within the geothermal potential area are not closed to leasing. These areas will follow the existing procedures for leasing outlined in Alternative A.

Davenport Power, LLC

Northwest Geothermal Company
225 NW Franklin Ave. Suite 1 Bend Oregon 97701
&
300 Atlantic Street Suite 301 Stamford, CT 06901

August 6, 2008

Geothermal Programmatic EIS
c/o EMPSi
182 Howard Street, Suite 110
San Francisco, CA 94105
emailed to: geothermal_eis@blm.gov

To Whom It May Concern:

Davenport Power, LLC is the operator for the Newberry Geothermal Project in central Oregon, and encourages efforts that will result in efficient development of geothermal energy resources on federal lands. We would like to commend you on the draft Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States; it is informative, well organized, and timely. Our interest lies in commercial electrical generation and our review therefore focuses on Volume I: Programmatic Analysis.

Davenport Power prefers the selection of Alternative B, with some modifications that are described in this letter. There is a dire need for the United States to move forward and proactively support, C-19-1
manage, and expedite leasing, exploration, and utilization of geothermal resources as a vital part of our country's energy future. Alternative A should not be selected, as this would not be a positive step and may only result in further delays to lease, explore, and develop the federal geothermal resources. Similarly, Alternative C should not be selected because it is based on commercial issues which are bested determined by the market and would therefore arbitrarily restrict future energy opportunities.

VALIDATION

There are important items that should be affirmed, acknowledged, or otherwise clarified in the PEIS to eliminate the risk of being misinterpreted. Two important points to validate are as follows: C-19-2

1. It is our interpretation that leases already issued within National Forests or on Public Lands would not be affected. Once a lease has been approved and issued, it will always be available for leasing, even after expiring or being relinquished.

2. It is our understanding that the PEIS would not supersede any existing legislation which C-19-3
includes provisions and conditions for geothermal leasing or development, such as the

November 5, 1990 legislation which created the Newberry National Volcanic Monument (Public Law 101-522).

PARTICIPATION OF BLM AND FOREST SERVICE

Davenport Power is pleased to see that the BLM and Forest Service are trying to work together to improve management and development of the federal geothermal resources. In our review of the draft PEIS, however, it appears that there are some critical problems. The PEIS states that each agency will take a different approach regarding how they implement and apply the analysis and the resulting decisions. Specifically, "BLM would amend 122 land use plans to adopt the allocations and the appropriate stipulations and the FS would use the PEIS to facilitate subsequent consent decisions for any leasing on NFS lands", as stated concisely in the Abstract. It is not clear how or why it was decided that the PEIS would not be used to amend or update existing Forest Plans and why additional leasing analyses are needed for the Forest Service but not for BLM. C-19-4

Both agencies are presumably equally obligated by the Memorandum of Understanding: Implementation of Section 225 of the Energy Policy Act of 2005 Regarding Geothermal Leasing and Permitting, which is included in Appendix B. The stated principles and goals of the MOU include making this a priority for both agencies and require supporting the nation's increased need for energy resources. We are concerned that there is a huge "disconnect" between the two agencies, as the PEIS is apparently sufficient for the BLM but not for the Forest Service. Both are federal agencies managing federal resources on federal lands; what laws require each agency to take a different approach and attitude to the same task?

Please clarify why the Forest Service will need yet another process to determine which parcels are available for lease, while the BLM does not. The PEIS is quite thorough and should have enough information for the Forest Service to make a reasoned decision regarding leasing, as BLM will do. Furthermore, the stipulations, best management practices, and universal mitigation measures can minimize or even eliminate any risks that the Forest Service may be fearing. We do not believe that additional time and analyses will result in leasing decisions that cannot reasonably be made at this time.

OTHER OPTIONS FOR FOREST SERVICE

Alternative B should be modified so that the Forest Service can use the PEIS to amend forest planning documents on each Forest that has the potential for geothermal resource leasing and development. The programmatic analysis, in order to be more useful, should identify lands for which the Forest Service would or would not consent to the issuance of geothermal leases. Forest Service should have the same decisions resulting from the PEIS as BLM, as described in section 1.11 Decisions to be Made. C-19-5

We suggest modifying the PEIS to give Forest Service the intrinsic capability to use the programmatic analysis to make leasing decisions and amend individual Forest Plans. We suggest the following be considered:

1. National Forest lands allocated as "general forest" should be declared open and available for geothermal leasing. This allocation is generally the most prevalent forest management allocation within a National Forest and is generally the least restrictive. Timber harvest, road construction, and many other common and perceptible uses are outright allowed in these areas. Geothermal exploration and development would in fact be much less obtrusive than many other allowable uses, and geothermal activities would generally be more than appropriate in this management allocation.

2. We believe the PEIS is seriously flawed in that it does not provide a means for Forest Service to utilize the PEIS to make leasing decisions without having to undertake further analyses and additional processes. The PEIS makes no mention of a schedule for the Forest Service to complete these additional analyses and we are skeptical that future analyses would be carried out in a timely manner. We suggest that the PEIS be revised to allow and require individual Forest Supervisors on affected Forests to use the PEIS to amend their Forest Plans and incorporate PEIS leasing decisions.

We are very doubtful that further analyses would be accomplished by the Forest Service in a timely or effective manner and believe that under Alternative B, leasing on Forest Service lands will in reality be no further advanced than it is under the No Action alternative. This may affect and significantly reduce the figures used in the PEIS to estimate the number of power plants constructed under the Reasonable Foreseeable Development scenarios. Without the ability to directly utilize the PEIS to make decisions, we believe that the Forest Service will not be improving the effectiveness of geothermal leasing.

There may be other opportunities to help expedite leasing efforts. Any means to help the Forest Service make timely and useful decisions based on the PEIS would be welcomed and should be considered.

POSITIVE ATTRIBUTES AND BENEFITS

There are a great number of positive attributes associated with geothermal energy, many of which would be especially evident when geothermal energy is compared to other energy projects and to other uses of public lands. The PEIS seems to focus on negative effects and overlooks positive effects. We would like to suggest a few benefits or positive aspects that should be addressed in Chapter 4 or Chapter 5:

1. It would be important for the PEIS to describe how well each Alternative accomplishes national objectives. This would be appropriate in response to national direction and policies requiring federal agencies to take appropriate actions to expedite projects that will increase the production, transmission, or conservation of energy, to provide initiatives to reduce greenhouse gas emissions, and to encourage renewable energy resources development. In most, if not all scenarios, a power plant generating electricity from geothermal energy will provide electrical power far beyond the local area in which a project is sited. Effects of leasing and geothermal energy production are important factors in terms of the national energy situation and should be described beyond a local level. When considering presumed negative effects, such as localized site disturbance, they must be considered in a larger and more global perspective. C-19-6

2. Geothermal is one of the many federal resources and just one of the multiple uses of federal lands and should be considered fairly with other approved uses on federal lands. The PEIS should address the amount of land disturbance associated with geothermal activities in comparison to other approved land uses on public and national forest lands. A quantified comparison between geothermal scenarios and other uses, such as timber sales, developed recreation sites, roads, oil and gas operations, and motorcycle or OHV trails and staging areas, for instance, would provide meaningful comparisons about the amount of land needed and the commitment of resources required to accommodate the types of uses that are apparently acceptable, already existing, and likely to continue. C-19-7

3. The PEIS should address the fact that geothermal facilities have relatively small footprints and can blend in and be compatible with the landscape, with other resources, and with other uses. Mitigation measures and careful siting can make projects nearly imperceptible to the typical Forest or public lands visitor. A comparison with developments that generate electricity from other forms of energy (coal, oil and gas, wind, or solar) would readily show how environmentally friendly and compatible geothermal development can be. Geothermal requires a limited number of acres to provide clean, renewable energy and serve a large number of people and homes. C-19-8

4. Active geothermal projects can support fire protection and suppression efforts. The PEIS should recognize that geothermal operations can be helpful and support early detection and suppression instead of mistakenly being discussed only as a potential cause of wildfire ignitions. In addition to working in areas cleared of vegetation (i.e.: well pads) that could effectively act as a fire break, geothermal operators are extremely concerned about safety and take many precautions to be safe, including being fire safe. Please address the fact that having geothermal personnel in remote areas mean that people are available to potentially see and report fires early. Additionally, geothermal operations usually involve heavy equipment and water, both of which could be quickly made available to help suppress fires that may occur in the general vicinity. C-19-9

OTHER COMMENTS
We have the following miscellaneous comments and suggestions for your consideration:

1. In most, if not all cases, it may indeed be appropriate to not allow geothermal activities in special designation areas; however, there should be no buffer areas created beyond the established boundary of any specially designated area. Buffer areas or restrictions to geothermal activities should not be imposed arbitrarily or just because of a general proximity to a particular area. Furthermore, most areas that have a special designation already incorporate a buffer area by design, and if one of these areas needed more protection it would have been considered and made larger when it was first established. C-19-10

2. Appendices J and K (page J-4 Table J-2 and page K-4 Table K-2), regarding Special Designation Areas, neglect to show that there is a National Monument on the Deschutes National Forest. The legislation that created the Newberry National Volcanic Monument (NNVM) is very important to geothermal leasing and operations and specifically addresses geothermal resources in this area. It is very important that this be properly included and addressed in the PEIS. C-19-11

3. We found two references in the PEIS where it implies that geothermal leases and operations are occurring or could occur within the "Newberry caldera" (page 2-37) or "Newberry crater" Appendix A, page A-33). The crater (or caldera) is within the Newberry National Volcanic Monument, and the legislation creating the NNVM specifically does not allow leasing or commercial geothermal operations in the crater. "Newberry Volcano" is the correct tem and should be used instead. C-19-12

We appreciate the federal agencies' efforts to expedite and streamline geothermal leasing and development processes. Thank you for the opportunity to comment.

Sincerely,

DOUGLAS S. PERRY
President
Davenport Power, LLC

cc: Bob Fujimoto, Forest Service Regional Office, R-6
Eric Hoffman, BLM Oregon State Office
John Allen, Forest Supervisor, Deschutes National Forest
Karl Gawell, GEA
Alice Tye, Environmental Consultant

C-19-1

Thank you for your comment. The commentor's preference for Alternative B is noted.

C-19-2

The decisions in the PEIS would not change the conditions of any leases already issued on National Forest or public lands. Lands with leases that expire or are relinquished would be evaluated to determine if the lands are still available for leasing (e.g., if an existing lease within a designated closed area expires, it would not be reissued). If the land is available for leasing, it would then have appropriate stipulations, in accordance with the PEIS decisions, placed on the lease parcel prior to offering it for competitive sale or issued as a direct-use lease.

C-19-3

The PEIS does not supersede existing legislation for geothermal leasing or development.

C-19-4

The Geothermal Steam Act requires that "geothermal leases for lands withdrawn or acquired in aid of functions of the Department of Agriculture may be issued only with the consent of, and subject to such terms and conditions as may be prescribed by, the head of that Department to insure adequate utilization of the lands for the purposes for which they were withdrawn or acquired" (30 USC 1014(b)).

In order for the Forest Service to determine whether to consent to issuance of a geothermal lease, and to determine what, if any, terms and conditions may be needed, site-specific analyses must be undertaken. NEPA provides the framework for the Forest Service to look at actions that may affect lands and resources, and to assess impacts, alternatives, and mitigation measures (lease stipulations).

Volume 2 of this PEIS provides the site-specific analysis of 19 pending lease applications. However, site-specific leasing decisions for any other NFS lands will be necessary in order for the Forest Service to make determinations of potential site-specific impacts, and identify site-specific mitigation measures.

C-19-5

The Forest Service follows the National Forest Management Act of 1976, and the Forest Service planning regulations promulgated under that act for land management planning (Forest Plans). The Forest Service is determining how to proceed with Forest Plan revisions and amendments due to recent revisions and conflicting court decisions. However, in order for the Forest Service to make geothermal leasing consent determinations, Forest Plans do not need to be first amended or revised. Forest Plans may be amended following a NEPA-based, site-specific leasing analysis and determination.

C-19-6

The Final PEIS identifies the BLM and Forest Service preferred alternative, which is based on meeting the stated Purpose and Need (Chapter 1), and includes meeting national objectives and evaluating environmental impacts.

C-19-7

The disturbance associated with geothermal activities is discussed at a programmatic level in Section 4.2 *Land Use*. General discussion of other land use activities is included in Chapter 4 land use, recreation, livestock grazing, and other resource sections.

C-19-8

The benefits of geothermal energy are discussed in various locations in the cumulative impacts discussion.

Small footprint size is discussed in Section 5.4.1 *Land Use*. The benefits of geothermal plants compared to fossil fuel plants are demonstrated in Table 4-2 *Hourly Carbon Dioxide Emissions at 2015 and 2025*. A comprehensive comparative analysis of impacts of geothermal development versus other energy sources is beyond the scope of this analysis.

C-19-9

The document has been revised to reflect your comment.

C-19-10

Given that impacts on geothermal resources from adjacent development may vary based on site-specific conditions, no specific buffer zone has been established for any lands. However, if it is determined in advance of leasing that exploration, development, or utilization of the lease parcel would "reasonably likely result in a significant adverse effect on a significant thermal feature of a National Park System unit," then BLM would be prohibited from issuing the lease (30 USC Section 1026(c)). Please see updated language in Chapters 1 and 2 related to protection of thermal features in NPS lands.

C-19-11

Based on the GIS data, there was no way to distinguish between National Monuments and other Congressionally designated lands; however, it is appropriately included in terms of acreages that are closed.

C-19-12

Thank you for the clarification. The management plan for the monument was reviewed, and changes were made in the Final PEIS.

HOT SPRINGS
LODGE & POOL

Glenwood Springs, Colorado

August 8, 2008

Geothermal Programmatic EIS
c/o EMPS
182 Howard Street, Ste 110
San Francisco, CA 94105

Public Comments
by
Glenwood Hot Springs Lodge and Pool, Inc.
Glenwood Springs, Colorado

Ladies and Gentlemen:

Glenwood Hot Springs Lodge and Pool, Inc. ("HSL&P") is pleased to submit these public comments concerning the published *Draft Programmatic Environmental Impact Statement for Leasing of Geothermal Resources in 11 Western States and Alaska* and comment in response to the solicitation in 73 FED. REG. 33802 (June 13, 2008).

HSL&P is a Colorado corporation. Its principal place of business is Glenwood Springs, Colorado. Its principal business is ownership and operation of the world famous Glenwood Hot Springs and Pool and its Lodge. This business and a significant part of the City of Glenwood Springs' economy rely on Glenwood's geothermal springs. HSL&P believes that without proper development safeguards, geothermal resource development could adversely affect HSL&P and the City of Glenwood Springs.

Application of geothermal waters on the North bank of the Colorado River for spa and pool purposes followed the founding of the Town of Glenwood Springs in 1884. The pool and its geothermally heated buildings represent substantial development of geothermal water resources. Feasibility and utility have been demonstrated for more than 100 years. Near contemporaneously South bank geothermal waters were also used.

Geothermal Adjudications

In its ownership, management and operation of the Glenwood Hot Springs and Pool HSL&P enjoys adjudicated water rights granted according to Colorado law. These are:

1. ***Mammoth Yampa Hot Spring*** Decree, entered Sep. 13, 1967, in Civil No. 1416 for 5.0 cfs absolute. C-20-1

2. ***Small Yampa Springs*** Decree, entered Apr. 29, 1982, in Civil No. 81CW415, for 0.3 cfs absolute.

3. ***Mammoth Hot Spring First Enlargement***, entered Mar. 11, 1996, in Civil No. 94CW167, for 1.86 cfs absolute, and 1.14 cfs conditional.

4. ***Hot Springs Area No. 1*** and ***Hot Springs Area No. 2*** (South-side Springs) Conditional Decree entered May 31, 1972, for 3.59 cfs (conditional).

5. ***Mineral Hot Springs Area No. 3***, Conditional Decree entered Feb. 28, 2005, for 0.445 cfs (conditional).

Concerns

HSL&P's concerns are three-fold:

First: These decreed water rights are artesian, naturally occurring surface springs.

Second: These surface geothermal springs result from local geologic faulting protected by a fragile, naturally occurring protective mantle identified in professional studies and reports as the Leadville Limestone formation. Once damaged this protective mantle probably cannot be remediated. If damaged it is probable area geothermal springs–the pool and a significant measure of the economy of the City of Glenwood Springs–will be adversely affected

Third: No one is certain of the extent of the artesian reach of Glenwood's geothermal springs. Interference with artesian flows may damage or destroy Glenwood's artesian geothermal springs, the pool and a significant measure of the economy of the City of Glenwood Springs. Studies commissioned by HSL&P suggest that the radius of this reach is approximately three miles surrounding Glenwood Springs.

HSL&P's concerns are supported by professional studies. Pertinent are those submitted with these comments. With one exception, these studies and papers have been scanned and reproduced on a Compact Disc ("CD") submitted as a part of these comments.

Federal Recognition of State Water Rights System and State Water Rights Adjudications

Water rights established under Colorado's Water Rights Determination and Administration Act and its prior adjudicatory procedures coexist with reserved federal water rights. Since enactment of the McCarran Amendment, 43 U.S.C. § 666(a), Congress established state courts as the forum for adjudication of federal and state water rights. *United States v. District Court, Eagle County, Colorado*, 401 U.S. 520 (1971); *United States v. District Court, Water Division No. 5, Colorado*, 401 U.S. 527 (1971). And see, *Winters v. United States*, 207 U.S. 564 (1908). C-20-2

In *Colorado River Water Conservation Dist. v. United States*, 424 U.S. 800, 819-20 (1976), the United States Supreme Court spoke unequivocally that,

> The consent to jurisdiction given by the McCarran Amendment bespeaks a policy that recognizes the availability of comprehensive state systems for adjudication of water rights as the means for achieving these goals.
>
> As has already been observed, the Colorado Water Rights Determination and Administration Act established such a system for the adjudication and management of rights to the use of the State's waters. As the Government concedes [footnote omitted] and as this Court recognized in Eagle County and Water Div. 5 [401 U.S. 520 and 401 U.S. 527], the Act established a single continuous proceeding for water rights adjudication which antedated the suit in [Eagle County and Water Div. 5, citations omitted]. That proceeding "reaches all claims, perhaps month by month but inclusively in the totality." Ibid. Additionally, the responsibility of managing the State's waters, to the end that they be allocated in accordance with adjudicated water rights, is given to the State [Water] Engineer. [*Id.* at 819.]

The United States Supreme Court reviewed with approval the statutory water rights adjudication and administration system of Colorado. It, like other western states, is a comprehensive system that has no federal counterpart, administrative or judicial. The Colorado system, as the Court observed, is an established system more comprehensive and orderly than piecemeal litigation in federal court.

This Congressional mandate and judicial approval has important application to geothermal resources on federal lands.[1] By requiring each prospective lessee-developer apply for and obtain an adjudicated state water right before actually attempting to recover geothermal resources puts that potential use in a comprehensive water rights system. The process permits an orderly, comprehensive determination that a proposed use is proper and will not interfere with or harm other water rights. As the Court also noted:

> Moreover, as Eagle County said, "questions (arising from the collision of private rights and reserved rights of the United States), including the volume and scope of particularly reserved rights, are federal questions which, if preserved, can be reviewed (by the [United States] Supreme Court after final judgment by the Colorado court." [*Id.* At 813.]

From these decisions, it is clear the United States recognizes adjudicated state water rights. A corollary to this adjudication process is the duty of the United States to protect previously adjudicated water rights, particularly those affecting or that may be affected by reserved waters.

---

1 The Colorado water rights system includes both surface and subsurface waters. Both are subject to adjudication and the scope of its comprehensive water rights system.

Accordingly, Glenwood artesian and other adjudicated geothermal rights are relevant to this rule-making process. Because of uncertainties inherent in extractive recoveries, provision must be made by federal rule to preserve antecedent artesian rights so federal geothermal leasing will not interfere with them.

Proposed Rule-Making Safeguards

1. Geothermal operating permits not be issued or withheld until such time as the lessee has applied for and obtained an adjudicated water right for the proposed use according the state law as required by the McCarran Amendment.

2. Geothermal leases not issue for such resources within five (5) miles of an existing municipality.

3. Geothermal leases not issue for such resources within five (5) miles of existing, adjudicated artesian geothermal occurrences. C-20-3

4. Prior to issuance of drilling permit, a geothermal lessee proposing to drill within fifteen (15) miles of existing, adjudicated artesian geothermal occurrences,

   a. conduct and submit a study that concludes to a professional certainty that proposed drilling shall not interfere with existing artesian geothermal occurrences, and

   b. give notice to all existing geothermal users within this area radius.

5. Any such professional study include consideration of all available literature, papers, and publications, if any, relative to or within a 15 mile radius of the proposed drilling site and/or geothermal resource.

Engineering-Geologic Studies & Reports
HSL&P CD

Like the terrain around Glenwood Springs, its geology and geothermal occurrences are complex. HSL&P has assembled and submitted with these comments a CD reproducing several of the more pertinent engineering-geologic studies. These explain HSL&P's positions and proposals. The reproductions are in ADOBE ACROBAT™ *.pdf* format. The CD contains a table of contents ("bibliography") with "links" to the reports described.

Very truly yours,

GLENWOOD HOT SPRINGS LODGE & POOL, INC.

By ______________________
D. Kjell Mitchell, COO & Gen. Mgr.

DJM:em
Encl.: CD

C-20-1

Prior to leasing, the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states typically manage and have regulatory authority for water quality, water rights, and wildlife. Site-specific impacts on water resources, including groundwater and artesian springs, would be addressed as part of the environmental analysis for the permitting process. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis, including public involvement, as appropriate. BLM and FS would work with interested and affected parties to identify and resolve user or resource conflicts. Appropriate site-specific mitigation would be developed, as necessary.

C-20-2

As discussed in Section 1.5.1, water rights are administered and adjudicated at the state level. Each prospective lessee-developer will be required to apply for and obtain an adjudicated state water right before actually attempting to recover geothermal resources (see Section 1.5.1).

C-20-3

As discussed in Section 1.5.1, geothermal leasing is guided by law (e.g., Geothermal Steam Act) and regulations, including the recently revised geothermal leasing and development regulations (43 CFR 3000, 3200, and 3280). The PEIS is not proposing to amend or change any of the laws or regulations; therefore, the PEIS cannot adopt the proposed rulemaking items discussed in the comment. Addressing site-specific issues is evaluated during the subsequent permitting process. The BLM and FS can apply conditions of approval on such permits to avoid and minimize any impacts to specific resources. While the BLM manages the geothermal resource (namely the heat), the state has primacy over the associated water resource. In accordance with state regulations, a lessee/operator must secure permits from the state before the BLM can issue a permit to drill either a temperature gradient well or a full diameter exploration well.

Furthermore, before issuing any leases the BLM would conduct the necessary review to ensure that leasing would be compatible with the local land use plan and site-specific resources in order to comply with all applicable state and local laws and regulations. As noted in Section 2.2.2, there are a variety of stipulations and BMPs that could be applied to protect sensitive issues and conditions.

GOVERNOR
Bill Richardson

DIRECTOR AND SECRETARY
TO THE COMMISSION
Bruce C. Thompson, Ph.D.

Robert S. Jenks, Deputy Director

STATE OF NEW MEXICO
DEPARTMENT OF GAME & FISH

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To order free publications call: 1-800-862-9310

August 15, 2008

Geothermal Programmatic EIS
c/o EMPSi
182 Howard Street, Suite 110
San Francisco, CA 94105

Re: Draft EIS for Geothermal Leasing in the Western United States; NMDGF Project No. 12159

To Whom It May Concern:

In response to the Federal Register Notice of Availability dated 13 June 2008, the New Mexico Department of Game and Fish (NMDGF) has reviewed the above referenced document. In addition to review of the document, NMDGF staff also attended the public meeting on July 22 in Albuquerque, New Mexico. The Bureau of Land Management and U.S. Forest Service have identified lands as either open or closed to geothermal leasing and propose lease stipulations and best management practices (Best Management Practices, BMPs) to be attached as conditions for specific project permits. The DEIS amends 122 land use plans (9 in New Mexico) to adopt the proposed allocations and stipulations and provides site specific analysis for 19 pending lease applications. None of the pending applications are in New Mexico; therefore NMDGF comments (below) only on Volume I of the DEIS.

The only known high-temperature geothermal system in New Mexico occurs in the Valles Caldera National Resource Area. NMDGF concurs with designation of the Valles Caldera as closed to geothermal leasing, due to significant wildlife habitat and other resource values. Via this letter, we request a map of lands open for leasing (versus specially designated and administratively closed areas in New Mexico) and at a scale which will allow us to evaluate other particular geographic areas for potential wildlife related concerns. A-21-1

Many native wildlife species potentially face adverse impacts as a result of recent climate change. NMDGF supports the development of geothermal resources for direct heating and for generating electricity, which creates dramatically less greenhouse gas than burning fossil fuels. NMDGF is in general agreement with the proposed stipulations and Best Management Practices. A-21-2

NMDGF appreciates the federal commitment to coordinate with state wildlife agencies in establishing wildlife-related seasonal or timing stipulations, as well as exception considerations, waivers or A-21-3 modification of such stipulations (2.2.2, p. 2-14 and 2-17). We appreciate the federal commitment to consider state listed and sensitive status species that occur on public land when analyzing project impacts (3.11, p. 3-153). NMDGF strongly supports the stipulation that requires monitoring of thermal features (2.2.2, p. 2-18). All potentially affected thermal features should be monitored, regardless of whether they are within lease boundaries or on public land.

NMDGF recommends the addition of BMPs that address the following wildlife protection issues to those listed in Appendix D:

- Pipelines conveying geothermal fluids are constructed above ground due to thermal gradient induced expansion and contraction. Pipelines are typically 24 to 36 inches diameter and rest on cradles above ground level, allowing small animals to pass underneath. Projects should be analyzed to ensure adequate passage for all wildlife species. The pipeline can be raised higher to allow wildlife passage where needed. Pipeline corridors through certain habitat types can alter local predator-prey dynamics by providing predators with lines of sight and travel corridors. Large projects should be analyzed to ensure there will be no significant changes to predator-prey balance.

- Ponds, tanks and impoundments (including but not limited to drill pits) containing liquids can present hazards to wildlife. Any liquids contaminated by substances which may be harmful due to toxicity, or fouling of the fur or feathers (detergents, oils), should be excluded from wildlife access by fencing, netting or covering at all times when not in active use. Liquids at excessive temperature should likewise be excluded. If exclusion is not feasible, such as a large pond, a hazing program based on radar or visual detection, in conjunction with formal monitoring, should be implemented. Clean water impoundments can also present a trapping hazard if they are steep-sided or lined with smooth material. All pits, ponds and tanks should have escape ramps functional at any reasonably anticipated water level, down to almost empty. Escape ramps can take various forms depending on the configuration of the impoundment. Earthen pits may be constructed with one side sloped 3:1 or greater; lined ponds can use textured material; straight-sided tanks can be fitted with expanded metal escape ladders. A-21-4

Install underground utilities as described below.

- To minimize the amount of open trenches at any given time, keep trenching and back-filling crews close together.
- Trench during the cooler months (October – March). However, there may be exceptions (e.g., critical wintering areas) which need to be assessed on a site-specific basis.
- Avoid leaving trenches open overnight. Where trenches cannot be back-filled immediately, escape ramps should be constructed at least every 90 meters. Escape ramps can be short lateral trenches sloping to the surface or wooden planks extending to the surface. The slope should be less than 45 degrees (100%). Trenches that have been left open overnight, especially where endangered species occur, should be inspected and animals removed prior to back-filling.

Appendix D refers to construction of geothermal facility associated transmission lines as described in APLIC publications. However, the citations are not shown. The relevant references are:

Avian Power Line Interaction Committee (APLIC). (1994). Mitigating Bird Collisions with Powerlines: The State of the Art in 1994. Edison Electric Institute, Washington, D.C. http://www.aplic.org

Avian Power Line Interaction Committee (APLIC) (2006). Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006. Edison Electric Institute, APLIC, and the California Energy Commission. Washington, DC and Sacramento, CA. http://www.aplic.org A-21-5

Thank you for the opportunity to comment on this Draft Programmatic EIS. If there are any questions, please contact Rachel Jankowitz at 505-476-8159, or rjankowitz@state.nm.us.

Sincerely,

for Terra Mauer

Matthew Wunder, Chief
Conservation Services Division

cc: Wally Murphy, Ecological Services Field Supervisor, USFWS
Mark Olson, NW Area Habitat Specialist, NMDGF
Scott Draney, NE Area Habitat Specialist, NMDGF
Pat Mathis, SW Area Habitat Specialist, NMDGF
George Farmer, SE Area Habitat Specialist, NMDGF

A-21-1

Concurrence on the Valles Caldera National Resource Area designation is noted. Communication occurred with the agency regarding information request.

A-21-2

Thank you for your comment. The commentor's agreement with stipulations and BMPs is noted.

A-21-3

Thank you for your comment. The commentor's support for stipulation for monitoring thermal features is noted.

A-21-4

The suggested BMPs have been reviewed and added to the document, as requested.

A-21-5

These are common BMPs; therefore, references have been removed from BMPs to correspond with all other BMPs.

Conservation
Congress

August 20, 2008

Geothermal Programmatic EIS
c/o EMPSi
182 Howard Street, Suite 110
San Francisco, CA 94105

Re: Draft Programmatic EIS for Leasing of Geothermal Resources in 11 Western States and Alaska

The Conservation Congress appreciates the opportunity to provide comments on said document. Please incorporate them into the record and analyze them prior to release of the FEIS.

"The goal of the PEIS is to examine the potential impacts of geothermal leasing on certain lands administered by the BLM and the USFS. Completion of the PEIS will improve the efficiency and effectiveness of the geothermal leasing and application process on Federal lands. The analysis in the PEIS will serve the following two purposes.

"(1) Analyze the impacts of leasing in areas that are determined through scoping to have reasonable near-term exploration/development potential for geothermal resources, including areas for which leasing applications have not yet been filed. The PEIS will thereby assist the BLM in determining how best to amend, as appropriate, its land use plans for these areas, by identifying the potential for geothermal development in the areas and determining the areas where geothermal development will be considered as an allowable use. The PEIS will similarly address USFS managed lands that have potential for geothermal resources and provide the basis for future geothermal leasing availability analysis and decisions.

"(2) Enable the BLM to reduce the backlog of lease applications that were pending on BLM and USFS administered lands as of January 1, 2005 by at least 90 percent as required by section 225(b)(3) of the Energy Policy Act of 2005. This Act gives the BLM until August 8, 2010, to achieve this goal. As of January 1, 2005, there were nearly 100 applications for geothermal leases pending on BLM and USFS lands. The PEIS will include the necessary site specific analysis to facilitate processing of these pending lease applications by deciding whether geothermal leasing is appropriate and under what stipulations they may be leased.

PO Box 5
Lewistown, MT 59457
406-538-4220

Comments are being solicited so as to determine:

(1) The scope of this analysis,
(2) significant issues or concerns related to the proposed actions, and
(3) alternatives to the proposed actions.

Conservation Congress Comments

Scope of the Analysis

It would appear the primary factor driving the PEIS is the backlog of pending lease applications. We suggest a more prudent and legally defensible course of action would be for the BLM to analyze only those existing applications rather than attempt to write a NEPA deficient EIS encompassing 530 million acres of land in 11 western states. 0-22-1

The PEIS should have been divided up by state at a minimum, and in order to facilitate useful public comment, prudently analyze the potential for geothermal leasing by each National Forest or BLM Unit. The seriousness and potential environmental impacts associated with allocating approximately 117 million acres of BLM lands and 75 million acres of National Forest lands to geothermal leasing can't be overstated. The DEIS fails entirely to adequately analyze the potential direct, indirect and cumulative effects of such action on a myriad of resources at risk. 0-22-2

According to the Federal Register Notice a reasonably foreseeable development scenario estimates a potential for 5,500 MW of new electrical generation capacity by 2015 through 110 new geothermal power plants and an additional 132 power plants by 2025 as a direct result of the approval of the proposed action.

In addition, the cumulative effects analysis failed to include basic NEPA-required information. For example, it doesn't appear that the cumulative effects analysis included how many other extraction programs are being allowed in the same areas? Or that the other extraction-leased areas were overlayed with the geothermal areas to show how much ground is *not* being developed and 'roaded'? 0-22-3

We do not believe the EIS would withstand legal scrutiny under NEPA for analysis of past, present and reasonably foreseeable future impacts on an estimated 530 million acres.

Significant Issues of Concern

We are significantly concerned about impacts to TES and rare and imperiled species; geothermal resources; and historic and heritage sites. Other than a list of generic stipulations and BMPs, there is no pertinent site-specific data regarding impacts to these resources. The EIS is incomplete and fatally flawed. 0-22-4

According to the PEIS:
"The BLM will provide further information at the scoping meetings regarding the locations of, and the planning areas and forests that may be affected by, the actively pending applications. The

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406-538-4220

purpose of the public scoping process is to identify issues that should be addressed in the environmental analysis and the scope of the alternatives."

Due to the short time frame involved in the scoping process we were unaware of the scoping meetings; none of them were within 100 miles of our office; and we would argue that information "regarding the locations of and planning areas and forests that may be affected by the actively pending applications" should have been substantively analyzed through the EIS process on a case-by-case basis. 0-22-5

Alternatives to the proposed action

In light of the aforementioned concerns, the only legally acceptable alternative is the No Action Alternative where lease applications would be evaluated on a case-by-case basis and would require additional environmental review and possibly land use plan amendments. We would suggest this is the lawfully proper course of action to take regardless. 0-22-6

Furthermore, the other action alternative – Leasing Near Transmission Lines Alternative – considered a larger buffer around Yellowstone National Park. We recommend that any alternative chosen for implementation should require the largest buffer possible around YNP. Despite decades of research little remains known about the plumbing system of YNP's remarkable geothermal resources. A reckless policy should not be implemented in an attempt to hurry through a few lease applications. 0-22-7

It is extraordinarily disappointing, although perhaps not surprising, that under the Bush Administration this illegitimate and reckless EIS is being rammed through. But the courts exist for a reason and this EIS is surely headed that way if it continues on its current path.

Please keep the Conservation Congress on the mailing list for this proposal and forward all relevant documents to our office address.

Sincerely,

Denise Boggs,
Executive Director

PO Box 5
Lewistown, MT 59457
406-538-4220

O-22-1

The purpose of the PEIS, as discussed in Section 1.2, is as follows:

- to complete processing active pending lease applications (discussed in Volume II); and
- to amend BLM land use plans to allocate BLM lands as open or closed to geothermal leasing and indentify appropriate stipulations, BMPs and procedures for geothermal leasing (as discussed in Volume I).

Site-specific impacts for subsequent geothermal exploration, drilling, utilization, and reclamation would be addressed during the permitting process or in separate NEPA documents.

The decisions for the PEIS and the pending lease analysis will be signed in separate RODs; therefore, decisions on the pending leases could occur separately from a decision on the programmatic analysis.

O-22-2

All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis. This document does predict a general level of anticipated future geothermal development in BLM areas that have geothermal potential, but it is not intended to provide full analysis of all phases of development. There are several subsequent stages of decision making necessary to approve geothermal resource development, each with its own environmental compliance requirements, including public involvement, as applicable. This document covers only the land use planning and lease issuance stages.

O-22-3

Additional discussion has been added to the cumulative impact analysis. As noted in Chapter 5, past, present, and reasonably foreseeable actions, including commercial uses of public and federal lands, are documented and analyzed.

O-22-4

As noted in response to comment O-22-2 above, all development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis.

O-22-5

Scoping meetings were held throughout the 12-state planning area. As explained in Section 1.11.3, this document covers only the land use planning and lease issuance stages and is not intended to provide full analysis of all stages of development. Site-specific impacts for subsequent geothermal exploration, drilling, utilization, and reclamation would be addressed during the permitting process in separate NEPA documents, if determined to be necessary.

O-22-6

The commentor's preference for no action alternative is noted. This document covers only the land use planning and lease issuance stages of geothermal development. All development, utilization, and reclamation activities would require further site-specific permits and associated environmental analysis.

O-22-7

Given that impacts on geothermal resources from adjacent development may vary based on site-specific conditions, no specific buffer zone has been established for any lands. However, if it is determined in advance of leasing that exploration, development, or utilization of the lease parcel would "reasonably likely result in a significant adverse effect on a significant thermal feature of a National Park System unit," then BLM would be prohibited from issuing the lease (30 USC Section 1026(c).

WYOMING GAME AND FISH DEPARTMENT

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August 28, 2008

WER 692.00
Bureau of Land Management
Federal Register
Notice of Availability
Draft Programmatic EIS
Leasing of Geothermal Resources in 11 Western
States and Alaska

Jack G. Peterson
Geothermal Programmatic EIS
C/O EMPSi,
182 Howard Street Suite 110
San Francisco, CA 94105

Dear Mr. Peterson:

The staff of the Wyoming Game and Fish Department has reviewed the Notice of Availability to prepare a Draft Programmatic Environmental Impact Statement for Leasing of Geothermal Resources in 11 Western States and Alaska. We offer the following comments for your consideration.

We suggest BLM review and consider our comments from our previous letter dated August 7, 2007. Several of our comments below are re-iterations of previous comments we believe remain pertinent to the project. In addition, we are providing new comments pursuant to recent directives from Governor Freudenthal and the Sage-Grouse Implementation Team under his direction.

On August 1, 2008, Governor Freudenthal issued Executive Order #2008-2 directing Wyoming State Agencies to emphasize the importance of managing Wyoming's Greater Sage-Grouse habitats and populations, to maintain the integrity of its status in Wyoming, and to avoid the species from being listed under the Endangered Species Act. Included in the Executive Order are directives to focus on maintenance and enhancement of Greater Sage-Grouse habitats and populations within Core Population Areas as identified by the Sage-Grouse Implementation Team, and to work collaboratively with federal agencies to maintain and enhance Greater Sage-Grouse habitats and populations. A-23-1

In light of the Governor's executive order, we encourage BLM to proceed with measures in Core Population Areas (see attached map) that maintain sage grouse breeding, nesting, and early brood-rearing habitats. Toward that end, we recommend protective stipulations surrounding leks to include 1) No Surface Occupancy within 0.6 miles of occupied leks, and 2) seasonal stipulations within 3 miles of occupied leks that prohibit surface disturbing activities from March 15 to July 15 each year to protect nesting and early brood-rearing habitats.

Geothermal power production may be one of the more environmentally friendly alternatives to generating electricity. Although relatively minor in comparison to other energy infrastructure, there are impacts associated with it that should be disclosed and addressed in the EIS. These include surface and habitat disturbance from plant construction, additional road construction and use, and power line impacts. Surface disturbance of key habitats can cause significant impacts to habitat use and wildlife populations. Roads fragment habitat, the associated traffic will increase wildlife mortality, and fences associated with roads may severely affect populations by blocking big game migration corridors. Power lines, if improperly sited and designed, can cause significant bird mortality, including sensitive species in some areas. A-23-2

We recommend that big game crucial winter ranges and parturition areas, and sage-grouse core areas and leks with associated nesting and brood-rearing habitat be removed from consideration for development. If this is not feasible, the EIS should include a process for planning mitigation measures for any energy plants that may be sited in key habitats, and to include our agency in that planning process. This mitigation may include a combination of methods, including proper siting of facilities, minimizing the habitat footprint, and reducing road and power line impacts. A-23-3

Thank you for the opportunity to comment.

Sincerely,

JOHN EMMERICH
DEPUTY DIRECTOR

JE:VS:gfb
Attachment

cc: USFWS

A-23-1

The sensitive species stipulation in Section 2-19 states the following:

> For agency-designated sensitive species (e.g., sage grouse), a lease stipulation (NSO, CSU, or TL) would be imposed for those portions of high value/key/crucial species habitat where other existing measures are inadequate to meet agency management objectives.

The BLM and FS have added the following procedure prior to leasing in Chapter 2:

> The authorized officer of the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states manage and typically have regulatory authority for water quality, water rights, and wildlife.

A-23-2

Impacts of surface disturbance are discussed at the programmatic level in the RFD scenario for each resource in Chapter 4.

In addition, all development, utilization, and reclamation activities would require further site-specific permits and associated environmental analysis.

A-23-3

The sensitive species stipulation in Section 2-19 states the following:

> For agency-designated sensitive species (e.g., sage grouse), a lease stipulation (NSO, CSU, or TL) would be imposed for those portions of high value/key/crucial species habitat where other existing measures are inadequate to meet agency management objectives.

The BLM and FS have added the following procedure prior to leasing in Chapter 2:

> The authorized officer of the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states manage and typically have regulatory authority for water quality, water rights, and wildlife.

In addition Appendix D provides a number of BMPs that would be applied as appropriate to protect sensitive species and habitats.

Wyoming Department of Agriculture

2219 Carey Avenue, Cheyenne, WY 82002 ■ Phone: 307-777-7321 ■ Fax: 307-777-6593 ■ Cust. Serv. Hotline 888-413-0114 ■ Website: wyagric.state.wy.us ■ Email: wda1@state.wy.us

The Wyoming Department of Agriculture is dedicated to the promotion and enhancement of Wyoming's agriculture, natural resources and quality of life.

Dave Freudenthal, *Governor*
John Etchepare, *Director*

August 18, 2008

Draft Geothermal Leasing PEIS
c/o EMPSi
182 Howard Street, Suite 110
San Francisco, CA 94105-1611

To Whom It May Concern:

Following are the comments from the Wyoming Department of Agriculture (WDA) pertaining to the Draft Programmatic Environmental Impact Statement (PEIS) developed by the Bureau of Land Management (BLM) and the United States Forest Service (FS) for geothermal leasing in the western United States.

Our comments are specific to our mission: to be dedicated to the promotion and enhancement of Wyoming's agriculture, natural resources, and quality of life. As this proposed project affects our agriculture industry, our natural resources, and the welfare of our citizens, it's important that we be kept informed of proposed actions and decisions and that we continue to be provided the opportunity to express pertinent issues and concerns.

This project will impact grazing permittees, agriculture producers, landowners, and other citizens, as well as our natural resources, both in and around each geothermal leasing project area. For these reasons, we are making the following comments to the Draft PEIS.

The WDA appreciates the Draft PEIS recognizing the importance of multiple uses on public lands, as evidenced in sections 3.2 and 3.13. Livestock grazing is an important aspect of multiple use and the impacts of energy development on livestock grazing are addressed competently in this Draft PEIS. A-24-1

However, we recommend you insert the following specific recommendations into the Final PEIS.

Section 4.13.3 - Exploration
The text currently lists several impacts to livestock grazing. We recommend adding the following effects to the current list: A-24-2

- gates left open due to travel to and from geothermal developments
- damaged range improvements (i.e. vegetation improvement projects)
- interference of livestock movement and herding due to increased roads and traffic
- introduction and spread of noxious weeds and invasive plants

Section 4.13.4 - Impacts under Alternative B
WDA supports the discussion of mitigation for dust control, litter, noxious weeds, and water. We recommend adding language addressing the loss of Animal Unit Months (AUMs) and reduced grazing land acreage. Such mitigation strategies and costs could include, but are not limited to the following: A-24-3

- movement of livestock to a vacant allotment or pasture
- monitoring of energy development impacts on vegetation
- purchase or lease of additional grazing land to replace lands temporarily lost for grazing
- reimbursement to producers for temporary loss of AUMs and pastures

Decisions in the proposed plan should allow BLM officials, FS officials, grazing permittees and private landowners the opportunity to work cooperatively. The WDA encourages flexibility to make the best site-specific, case-by-case decisions that are in the best interests of the affected resources and citizens throughout the geothermal energy production process. A-24-4

In conclusion, we appreciate the opportunity to comment on the scope of Draft PEIS for geothermal leasing in the western United States. We encourage continued attention to our concerns and we look forward to being informed and involved in proposed actions and decisions.

Sincerely,

John Etchepare
Director

JE/jc

CC: Governor's Planning Office
Wyoming Game and Fish Department

A-24-1

Thank you for your comment.

A-24-2

The suggested additional impact of "interference of livestock movement and herding due to increased roads and traffic" is included in the discussion of development impacts in the Draft PEIS. Additional suggested impacts have been reviewed and added to Section 4.13, as appropriate.

A-24-3

The following BMP has been added in Appendix B to provide the most flexibility in response to individual situations:

- work with livestock operators to minimize impacts to livestock operations.

A-24-4

Thank you for your comment. The PEIS allows the flexibility of individual BLM land use plans to adopt the appropriate BMPs and stipulations.

From:	Mommy Jackson
To:	Zoe Ghali
Cc:	Mommy Jackson; tea_tunes@yahoo.com
Subject:	Geothermal Leaseing Project Comment
Date:	Monday, September 08, 2008 4:01:35 AM

Zoe,

I am submitting my comments for the Geothermal Leasing Project.

I request that the DEQ mandates a full review from the Environmental Quality Commission on the basis of the Three Basin Rule for the proposed geothermal leasing within the Willamette NF, the 1,115.280acres of land that are in a river valley centered on the North Santiam River. This is a drinking water source for a major population in Oregon. (Salem, and Stayton etc.) The potential for public health hazards, as well as the impacts to wildlife, fish and plant habitat is unacceptable. The Forestry Department is required to protect the operations on State and private lands and follow water quality standards that are intended to be attained and are implemented through best management practices and other control mechanisms established under the Forest Practices Act (ORS 527.610 to 527.992) and rules thereunder, administered by the Oregon Department of Forestry. Therefore operations within the Forest Practices Act are required to be in compliance with this rule. The DEQ works with the Oregon Department of Forestry to review the Forest Practices program so that it attains water quality standards. The waters and tributaries are identified as "Fish Use Designations" for Salmon and Stealhead Spawning. A 401 water quality certification may contribute to warming of State waters beyond 0.3 degrees Celsius (0.5 degrees Fahrenheit), and are therefore designated as water-quality limited, to develop and implement a temperature management plan that would not be achieved by the geothermal plant with unapplicable temperatures. I-25-1

The Mt. Hood propsed site is within an unstable earthquake area. There are many faults in the area which would impact Portland and surrounding areas should it trigger an earthquake during the drilling process. This is an unacceptable impact. I-25-2

Sincerely,
Irene Jackson
momjackson3@gmail.com

487 N. Myrtle Avenue
Stayton, Oregon 97383
503-769-6992

I-25-1

The comment is noted. This is a request of the Oregon DEQ and does not require any direct changes to the PEIS. The DEQ received the PEIS for their review.

I-25-2

As stated in Section 4.3.2, geothermal use generally involves reinjection of fluids after use for a net zero change in fluids. This represents a low risk for increased seismic activity.

MINION HYDROLOGIC
61006 JAY JAY ROAD
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3 September 2008

Zoe Ghali
EMPS Inc.
3775 Iris Avenue, Suite 1A
Boulder, CO 80301

Draft Geothermal Leasing PEIS
c/o EMPSi
182 Howard Street, Suite 110
San Francisco, CA 94105-1611

Re: Comments on the Draft PEIS for Geothermal Leasing in the Western United States

To Whom It May Concern:

Commentary regarding the Draft PEIS for Geothermal Leasing in the Western United States, primarily directed at Alternative B (the proposed action), are provided in this report.

SCOPE OF PEIS

It is stated in the Draft PEIS for Geothermal Leasing in the Western United States (hereafter PEIS) that **"leasing land does not involve ground-disturbing activities or any type of construction, so there would be no direct impact on water resources. Indirect impacts would result from activities pursued after leasing"** (pg. 4-40). Impacts which occur to water resources from leasing provided via the PEIS would not have occurred without the lease process, thus specific broader range water resource protection concepts should be considered as a primary part of the PEIS. The Draft PEIS approach of relying on regional BLM or FS BMP's, individual State, and/or other local governments to protect existing geothermal resource users, or to provide the expertise for supplying the broader range water protection parameters, creates a high potential for damage (injury) to existing geothermal springs, wells and decreed geothermal water rights throughout the Western US. C-26-1

Under the PEIS Purpose and Need for Action (PNA) Section, Item 1.2 - The purpose is stated as, **"To amend BLM land use plans to allocate BLM-administered lands with geothermal resource potential as closed, open, or open with major to moderate constraints to geothermal leasing. This includes establishing a projected new**

level of potential geothermal development with existing planning level decisions (termed reasonably foreseeable development scenario), and identifying appropriate stipulations, BMP's, and procedures to protect other resource values and uses while providing sufficient pre-leasing analysis to enable the BLM to make future competitive geothermal leasing availability decisions" (includes FS lands).

"The planning area includes BLM- and FS-administered surface lands with minerals under federal ownership that have geothermal potential and the subsurface federal mineral estate on other lands" (PEIS Executive Summary (ES) Section ES.4.). "The BLM cannot lease lands over the objection of the FS. The FS makes their consent decision after conducting a leasing analysis, including NEPA... This leasing determination will be used to amend FS land use plans as appropriate" (PEIS PNA Section 1.5.4).

There are several sections within the PEIS regarding issues related to water resources. In order to minimize the potential for damage to existing geothermal resource users it is recommended that drilling for, and utilization of, geothermal resources for energy extraction be limited within the PEIS as follows:

1) Lease applications received by the BLM or FS should not be reviewed in-depth until notice of the lease applications have been forwarded to all existing geothermal water right owners and existing geothermal resource users located within 2 miles of the proposed lease area. The existing geothermal users should have at least 60 days to comment regarding concerns, etc. to the BLM and/or FS as part of the lease review process. This is important, as the lease periods run for long duration time periods. **As stated in PEIS PNA Section 1.5.3 - A lease is issued for a primary term of 10 years and may be extended for two five-year periods... At any time a lease may receive a 5-year drilling extension...** C-26-2

   It is also stated, **"Geothermal exploration and production on federal land conducted through leases is subject to terms and stipulations to comply with all applicable federal and state laws pertaining to various considerations for tribal interests, sanitation, water quality, wildlife, safety, cultural resources, and reclamation" (PEIS PNA 1.5.3).** The concept of protecting existing decreed geothermal water rights or existing geothermal resource users from injury due to geothermal drilling, exploration or utilization is not mentioned in any section of the PEIS dealing with water resources.

2) Any subsequent applications for drilling permits within a geothermal lease area should be forwarded from the lease applicant to all existing geothermal users within the 2 mile

area as identified under item 1) above. The notice should be sent by certified mail, return receipt requested, and should include a copy of the permit application to the BLM and/or FS. Once the notice is received, the local geothermal resource users should have at least 60 days to provide comments or written objections if they are opposed or seek modifications to the proposed drilling program.

The process of giving notice will allow for adjacent existing geothermal water right owners and resource users to work on installation of pre-drilling monitoring structures 'up-front'. In this fashion, baseline data can be collected which actually confirms if there is non-injury to the existing proximate geothermal resource users.

3) As part of the PEIS, no geothermal exploration drilling should be permitted within one (1) mile of decreed geothermal water rights, or existing geothermal springs and wells which are currently utilized by local resource users. This includes any vertically or directionally drilled well for either geothermal production (resource producing well) or for closed loop systems. Any geothermal well drilled within a 2-mile proximity to an existing geothermal resource user should only be permitted in a downgradient direction (in terms of the aquifer ground water gradient).

These restrictions could be lifted if all of the geothermal water right owners and resource users within the 1-mile and 2-mile area(s) described above agreed to waivers. In this fashion, if all of the existing geothermal water right owners and resource users within the 1-mile and 2-mile restriction areas were not concerned about immediately adjacent geothermal resource development the lease applicant could proceed without these restrictions.

The above comments regarding the necessity for inclusion of broader range water resource (primarily geothermal resource) protection parameters within the PEIS are valid based on the stated purpose under PEIS PNA Item 1.2 (shown above). **PEIS PNA Item 1.9.1 - "This PEIS... analyzes the broad impacts associated with allocation of geothermal resources for leasing along with the adoption of stipulations and BMP's. As such, it meets the intent of the implementing regulations for the NEPA, which state, <u>"Agencies shall prepare statements on broad actions so that they are relevant to policy and are timed to coincide with meaningful points in the agency planning and decision making"</u> (40CFR 1502.4). The PEIS does not evaluate site-specific issues associated with geothermal exploration, drilling, utilization, or reclamation and abandonment. Site specific impacts for subsequent geothermal exploration,** C-26-3

drilling, utilization, or reclamation and abandonment would be assessed during the permitting process and in separate NEPA documents prepared by local BLM and FS offices. Such analysis could tier to this document in accordance with NEPA implementation regulations (40CFR 1502.20)" (emphasis added).

Background knowledge leading to the request for inclusion of items 1) - 3) listed above into the PEIS are based on over 20 years of personal experience working on geothermal projects within Western Colorado.

Inclusion of items 1) - 3) listed above into the PEIS would greatly reduce the potential for injury to existing geothermal resource users and the frequency of resource damage related lawsuits. This approach would also reduce much of the uncertainty for potential geothermal resource developers applying for leases. Many of the potential geothermal lease applicants may have no concept of geothermal water rights or geothermal use injury issues. The notice requirements for both the initial lease and subsequent drilling permit would help the lease applicants gain knowledge of local geothermal water right owners and resource users. The one-mile no drilling protection zone discussed above would assist with minimizing damage to existing geothermal resource users.

As stated under the PEIS BMP's for water resources under the Exploration, Drilling and Construction and Utilization phases of a lease (listed on pages D-7, D-22, D-38 - Mitigation Measures - Volume III - Appendices) - **"Operators shall gain a clear understanding of the local hydrogeology. Areas of ground water discharge and recharge and their potential relationships with surface water bodies shall be identified... Operators shall avoid creating hydrologic conduits between two aquifers during foundation excavation and other activities".**

A lease applicant may be willing to state 'up-front' through basically 'surficial hydrogeologic studies' that their proposed well or appropriation will not materially injure a valid geothermal right (or user), but this assertion cannot be proven until the well(s) is drilled and potential effects have been proven through aquifer testing/monitoring. It will probably not be possible to accurately understand local hydrogeology without data from several well tests, especially in fractured geologic formation type geologic settings which is certainly the case in Western Colorado. C-26-4

Once any injury occurs, the only option in terms of geothermal water supply is to offer 'replacement geothermal water'. The concept of the lease applicant obtaining and offering to provide to any affected party an equivalent amount of replacement water of comparable quality is very difficult to perform. There can be significant water quality differences in geothermal waters within a very limited geographical area. In addition, piping of replacement geothermal water from a well to another area is often a logistical problem for the affected pre-existing geothermal use operation, due to pipe scaling, equipment failure, power failure, potential new pump and pipe installation(s), etc. These issues can be very problematic, especially for business operations which depend on continuous flow of the geothermal waters. People, or groups, who own geothermal water rights or utilize geothermal resources generally have much invested in their operation. The operation is based not only on a typical flow regime and source type (spring or well), but also on the given geothermal temperature and water quality, including the pH of the geothermal water.

Another major problem with the 'replacement water' concept is the public perception of 'naturally flowing' geothermal spring water versus geothermal water from a well, or from artificially heated water. There is no special allure to a heated swimming pool or hot tub; the real value of the geothermal spring water at many places of use is the perceived, and actual, health benefits from the 'naturally occurring' minerals in the water (see Colorado Geological Survey Bulletin 11 - "Mineral Waters of Colorado" for a scientific analysis). People do not travel great distances to soak in a spring which is filled and maintained with 'replacement geothermal water'.

The potential for injury to existing geothermal users cannot be adequately determined 'up-front' through assumption and theory processes. The only way to accurately know is to set-up monitoring networks and obtain adequate baseline data prior to drilling a geothermal well. The best approach for facilitating this type of process is a requirement to give notice to the geothermal water right owners and resource users located within 2 miles of a potential lease area during both the lease process and as part of obtaining a well permit.

Basically, the hydrogeologic conditions are what the testing shows. If a lease applicant can drill and test the well(s) and show no injury to adjacent proximate geothermal water right users they can claim their appropriative amount. If the drilling and testing does show injury, and the lease applicant cannot supply the injured party with geothermal water which is 'equivalent' (in terms of flow, temperature, water quality and source type - from a spring source or a well source), the lease applicant should not be able to appropriate the geothermal resource. Experience has shown there is potential for injury simply due to drilling or other types of excavation, and as such this PEIS should include the 1-mile no drilling protection zone.

The 1-mile no drilling protection zone for existing geothermal resource users and water right owners is recommended to greatly reduce the potential for lawsuits regarding injury from geothermal drilling. Experience has shown that suing government agencies is frustrating and expensive as governments generally have limited liability. Assuming some of the larger oil companies become involved in the geothermal prospecting business, it would be very expensive to sue due to their nature of 'dragging things out' in Court with the intention of bankrupting the other side. It is the BLM and FS responsibility to proceed with geothermal leasing within this PEIS in a manner which carefully considers and includes protections for existing geothermal water right owners and resource users.

Perhaps the best way of bringing into perspective the potential concern for proximate construction of geoexchange well systems or geothermal production wells is to assume you own and operate a geothermal spring and your neighbor intends to drill a vertical geoexchange or production well. This type of scenario could actually occur in several small towns and lodge/spa facilities located very proximate to Federal lands in Western Colorado, and likely in other locations throughout the Western US.

Under PEIS ES Item ES-4 - **"This PEIS analyzes the potential environmental, social, and economic effects of these actions in accordance with the NEPA, the CEQ regulations for implementing NEPA, and applicable BLM and FS authorities". On PEIS page 3-198, under the Socioeconomics and Environmental Justice Section - "Areas of high geothermal potential are often located in rural areas, which typically have chronic, high unemployment rates. The development of geothermal resources in such rural areas can improve local socioeconomic conditions... the idea that a single expenditure in an economy can have repercussions throughout the entire economy. The long lifetime of geothermal plants means that they can become a stable, reliable part of a community's economic base (National Geothermal Collaborative 2007)".**

PEIS ES-4 statement indicates the social and economic effects of the proposed geothermal leasing must be considered. The subsequent statement on PEIS page 3-198 is erroneous in regard to Western Colorado, and likely many other geothermal spring or well use areas in the Western US. Many of the existing geothermal use areas have thriving lodging and spa businesses which are basically the lifeblood of the communities. Depletion in geothermal flows at any of these areas would create economic and social hardship, not improve socioeconomic conditions. The existing lodging and geothermal spa facilities are the stable, reliable part of these communities' economic base, which could be seriously disrupted by proximate geothermal drilling and associated depletive effects to the geothermal resource. In regard to tourism, the average tourist's interest in geothermal power plants is not nearly as high as their interest to soak in naturally occurring geothermal hot springs.

Other specific comments regarding water resource related issues, as stated within the PEIS, are given in the Water Resource (Geothermal) Issues section of this report.

STATE OF COLORADO

In PEIS ES-1 it is stated, **"The BLM has the delegated authority to issue geothermal leases on federal mineral estate, such as that underlying lands administered by the FS. A geothermal lease is for the earth's heat resource where there is federal mineral estate... Leasing geothermal resources by the BLM vests with the lessee an exclusive right to future exploration and to produce and use the geothermal resources within the lease area subject to existing laws, regulations, formal orders, and the terms, conditions and stipulations in or attached to the lease form or included as conditions of approval in permits".**

PEIS PNA Item 1.5.1 - Geothermal Leasing Laws and Regulations - **"A geothermal lease is for the heat resource of the earth where there is a federal mineral estate. Unless specifically owned in fee, the federal government does not own the hot water commonly associated with the heat; this falls under state water laws. Geothermal developers must obtain the appropriate water rights and state permits, in addition to the federal lease for the resource."** PEIS PNA Item 1.9.1 defines the Planning Area as including **"BLM and FS-administered surface lands with minerals under federal ownership that have geothermal potential and the subsurface federal government mineral estate on other lands".** C-26-5

In the State of Colorado, there are existing Rules regarding the permitting and development of geothermal resources. The title of these Rules are as follows: State of Colorado, Division of Water Resources, Office of the State Engineer - "Rules and Regulations for Permitting the Development and Appropriation of Geothermal Resources Through the Use of Wells" (Geothermal Rules) - 2CCR 402-10, with an effective date of 30 September 2004. These Rules are a revised version of the initial 1994 Geothermal Rules. Any drilling of geothermal wells on Federal lands (BLM/NFS) within the State of Colorado are subject to these Rules. In Colorado, the heat contained within geothermal water is not a mineral right, it is an integral part of any decreed geothermal water right. A copy of the Geothermal Rules are shown in attached Appendix A.

The initial 1994 Geothermal Rules were promulgated pursuant to a lawsuit filed against the Colorado State Engineer's Office (SEO) by owners of geothermal springs in Ouray, Colorado for the SEO's lack of regulation/oversight of geothermal permitting and drilling during the late 1980's. Several geothermal wells were drilled within Ouray, and several geothermal springs were affected. The flow in the geothermal springs at one Lodge was significantly reduced, and the discharge of a different geothermal spring at another Lodge facility ceased altogether.

PEIS PNA Section 1.6.2, Table 1-1 - Lists BLM lands of 6,289,076 acres and NFS lands of 15,347,069 acres included in the Geothermal Potential Area (Planning Area). Review of Figure 1.5 shows this includes almost all of western Colorado.

Under PEIS Proposed Action and Alternatives (PAA) Section Item 2.5.1, Table 2.7 - Commercially Viable Geothermal Capacity for Electrical Generation by High Potential Area - lists under Colorado the following Hot Spring Areas of potential - Wuanita, Routt, Cottonwood, Mt. Princeton, Poncha and Pagosa Hot Springs, Wagon Wheel Gap, Orvis and Ouray Hot Springs. A copy of PEIS Appendix F, pg. F-10 which lists geothermal areas of interest in Colorado is shown in attached Appendix B. There are numerous existing geothermal users and geothermal water right owners located within the areas listed on PEIS Table 2.7 and Appendix F, pg. 10.

Under PEIS PAA Section Item 2.2.2 - Lease Stipulations - **"Lease stipulations are major or moderate constraints applied to a new geothermal lease. A lease stipulation is a condition of lease issuance that provides a level of protection for other resource values or land uses by restricting lease operations during certain times or locations or by mitigating unacceptable impacts, to an extent greater that standard lease terms or conditions".**

A standard item which should be included in any lease stipulations for Western Colorado (as well as much of the potential lease area in the Western US) should be that geothermal drilling and aquifer testing be limited to the time periods of geothermal spring baseflow. This time period generally extends from November through early March of any given year.

Longer-term monitoring of geothermal springs at several sites in Western Colorado has shown annual fluctuations in spring discharge. Generally, the best time period for measuring geothermal spring baseflow is during the winter months. The late fall/winter seasons are the best time period for drilling and performing aquifer testing on new geothermal wells, as there are no significant outside influences (increased recharge, etc.) affecting the geothermal springs, and the baseflows generally remain fairly constant. During this time period any potential impacts or injury from new geothermal well drilling, testing or production can be more readily ascertained.

No new geothermal well drilling or testing should be permitted to occur during the run-off through mid-summer time periods, as the flow rates, and sometimes temperatures, from geothermal hot springs can vary significantly. Any potential impacts to existing geothermal users from drilling and testing activities during this time period would be much more difficult to determine.

Review of the Colorado Geothermal Rules shows, among other items, that it is required for applicants applying for geothermal exploration well permits to "give notice of the proposed well construction to the owners or operators of any valid, prior water or geothermal rights that are located within one half (½) mile of the proposed well.... The application shall specify whether the well will be used to explore or appropriate a geothermal resource, and if so, specify the proposed production rate and disposal of a geothermal fluid. Any secondary uses of a geothermal fluid or recovery of by-products shall be identified in the application. The application shall be supplemented with evidence showing that notice was given..."

Increasing the area for lease and drilling notices in the PEIS to 2 miles and not allowing drilling within 1 mile of existing geothermal water right owners and resource users is based on the difficulties for a geothermal water right owner or resource user to coordinate regulations, issues, concepts, etc. with both Federal and State government agencies. However, the notice and drilling protection concepts are primarily due to the potential for high magnitudes of resource extraction and associated aquifer impacts associated with a geothermal energy plant. PEIS Section PAA Item 2.5.1 states, **"... it appears that production of geothermal fluids could be expected to vary widely from one to six million gallons per well, per day".** One well producing one million gpd is equivalent to an average pumping rate of 694 gpm for a consistent 24-hour period every day. PEIS Section PAA Item 2.5.2, states **"Direct use resources are more likely to be developed when they are in proximity to existing communities".** This statement basically clarifies the intent is to drill production wells in proximity to communities which are already utilizing the geothermal resources for their socioeconomic base.

The requested inclusion within the PEIS of items 1) - 3) on pages 2-3 of this report will help avoid injury to existing proximate geothermal resource users. However, higher yield direct use geothermal power plants could still impact existing geothermal resource users especially if the geothermal resources are being produced from confined aquifer conditions. The inclusion of request items 1) - 3) would not eliminate the requirements for long-term aquifer testing to ascertain depletive impacts from new geothermal wells.

WATER RESOURCE (GEOTHERMAL) ISSUES

Relevant issues which infer the potential for injury to existing geothermal springs and/or wells are mentioned under several sections of the PEIS. Several of these PEIS statements are shown below along with subsequent commentary.

PEIS Section PAA Item 2.5.1 - **"Looking to the future, it is likely that most direct use applications will not be able to draw from existing surface manifestations as they have in the past. Surface manifestations such as naturally occurring hot springs have become increasingly sought after with increases in population in the western US, increased recreational use, and more stringent regulations preserving such resources for their recreational, cultural or scenic value. In such cases where surface manifestations are not nearby or are not being utilized directly, exploration activities similar to those described above for indirect use would also apply for direct use".** C-26-6

The surface manifestations described (geothermal springs) are basically surface manifestations of the local ground water table(s). Drilling and/or production within proximate distances to the geothermal springs can cause injury to spring flow rates and/or water quality.

Section 3.7 Affected Environment - Water Resources and Quality (WRQ) pg. 3-72 - **"Ground water is the primary water resource that is potentially affected by geothermal exploration and development. Potential effects to surface water are more limited in area and scope to the immediate vicinity of geothermal exploration and development activities...** C-26-7

These statements justify the need for the 1-mile no drilling protection zone and the 2-mile notice area.

PEIS WRQ Section pg. 3-218 - **"Drilling activities can result in the pollution of shallower water aquifers with drilling fluids as wells are bored through them, although this effect is limited to the duration of drilling. Well casing is used upon well completion, which separates geothermal fluids from any shallower aquifers that a drilled well may pass through. Ground water contamination can occur in rare situations involving a well casing break or the percolation of surface-discharged geothermal fluids... Surface water bodies can be contaminated from either surface discharges or spills of geothermal fluids, or underground contamination of springs that feed a surface water body. Surface discharges are regulated through state and local permits, and abatement technologies are installed as necessary to reduce contaminants to acceptable levels".** C-26-8

This statement is a broad oversimplification of the potential concerns associated with well drilling. Simply installing a well casing does not guarantee a seal between aquifers, or even along the borehole and the casing. It is difficult to adequately seal the borehole/casing zone; it is even more difficult to seal-off water producing zones within a well. These seals can be viable for shorter time periods; it is very difficult to maintain these well seals over longer time periods.

PEIS Section on Environmental Consequences - Impacts on Water Resources and Quality (IWRQ) Section 4.7.3, pg. 4-43, **Drilling Operations - "BLM and FS guidelines and state regulations for maintaining and plugging and capping wells to prevent blowouts and mandating proper well casing and drilling techniques would minimize the risk of impacting surface water and ground water in the immediate area". Blow-out prevention equipment would be required in areas of known artesian pressures** (PEIS PAA Section 2.5.1). C-26-9

In Western Colorado there have been wells drilled which encountered unexpected artesian flows of geothermal water. Any drilling within a proximate boundary of the proposed 2 mile notification radius should be equipped with blow-out prevention equipment.

PEIS IWRQ Section 4.7, pg. 43 - **"Ground water extraction and injection wells are installed and pumped to cycle geothermal fluids within the geothermal reservoir to remove heat energy. To be effective, it is desirable to create an efficient circulation system where the injected (cool) fluid is resident in the formation long enough to heat up to the maximum temperature without significantly altering subsurface pressures". Most geothermal fluids produced are re-injected back into the geothermal reservoir, via reinjection wells** (PEIS PAA Section 2.5.1 pg. 47).

C-26-10

A main concern with cycling fluids within the well is the potential for decreasing the temperature within the geothermal aquifer. There is no accurate 'up-front' way to determine the effects to temperatures of adjacent geothermal springs due to fluid reinjection within the geothermal aquifer. In addition, re-injection of fluids which are not contained in a closed loop system could be a problem in areas with geologic faulting (as is the case in most fractured geologic settings). Introducing fluids into fractured and faulted geologic formations could result in increasing the earthquake potential in the area (e.g. Rocky Flats near Denver, CO, etc.).

PEIS IWRQ Section 4.7, pg. 4-43, **"Extracting geothermal fluids could result in drawdowns in connected shallower ground water aquifers, with the resulting potential to affect streams or springs that are in turn connected to the water table aquifer. The potential for these types of adverse impacts is reduced through** C-26-11

extensive aquifer testing, which is the basis for designing the geothermal plant and for locating, designing, and operating the extraction and injection wells. Combined with the requirement to comply with state and federal regulations that protect water quality and with limitations imposed by water rights issued by the state engineer, the impacts on water quality and the potential for depleting the water resources is expected to be minimized. <u>There is a medium risk for moderate to high impacts on ground water supplies from the use of ground water for geothermal activities"</u> <u>(emphasis added).</u>

As discussed in the State of Colorado report section (pages 7-9 of this report), the Colorado SEO had to be enjoined in a lawsuit before Geothermal Rules were promulgated in Colorado. The drilling and aquifer testing described above as reducing the potential for injury to existing geothermal users has in fact been the cause of permanent damage to geothermal water rights and resources at existing lodge and geothermal spa facilities in Western Colorado. Expectations that the measures stated on pgs. 4-46 and 4-47 (Impacts under Alternative B) would protect water resources do not say anything about protection of existing geothermal (hot) springs or wells.

PEIS IWRQ Section pg. 4-45, **Utilization - "Hot springs are surface features that indicate the presence of geothermal features deep within the earth. These springs can be part of sensitive ecosystems, recreation areas, or traditional cultural properties. The geothermal resources that would be developed are usually at greater depths that the shallow ground water associated with the hot springs. However, withdrawing shallow ground water or surface water for cooling purposes could affect nearby springs".**

This statement is contradictory. The stated concept appears to be that the existing hot springs indicate the presence of geothermal features deep within the earth, yet are somehow not connected to this deep source. This assumption seems to be fairly widespread, that there is much more geothermal resource within a given area than is indicated by the naturally occurring flow of the geothermal hot springs. Yet, drilling in areas of Western Colorado has not shown this is the case. Drilling, pumping and/or flowing of artesian geothermal wells has shown impact (injury) to adjacent hot springs. C-26-12

If there is such confidence that there is greater geothermal potential at depth in areas of existing geothermal springs, it should be no problem to encounter this potential at distances of greater than one (1) mile in a downgradient ground water table direction from any existing decreed geothermal water right owner or resource user.

PEIS Section IWRQ pg. 4-45, **Reclamation and Abandonment - "Improper abandonment could allow the wells to serve as pathways for geothermal fluids to migrate to other aquifers, affecting both the geothermal resource and other ground water quality. Proper well closure and capping would reduce the risk of these impacts".**

Well closure and capping may not reduce the risk of these impacts. In fact, use of final production wells will not reduce this risk. As prior stated, it is very difficult to maintain longer term well seals between the well casing and the borehole, and between aquifers within a specific well. It almost has to be assumed that long-term there will be contamination between aquifers within any well drilled for geothermal production. C-26-13

PEIS Section PAA Item 2.5.1 pg. 49 - **"The cost in exploration of geothermal resources for direct use is a limiting factor in many direct use proposals. Drilling exploration wells is cost-intensive and there is no guarantee of finding a sufficient resource on first attempt".** C-26-14

This cost concern will lead to the desire to drill geothermal wells in proximity to known geothermal spring/well areas. Thus, it is important to establish the reasonable 2-mile area lease notice and the one mile 'off limit' drilling zones to protect known geothermal water right owners and resource users as part of this PEIS.

PEIS Section on Cumulative Impacts and Other Considerations (CIOC) - Water Resources 5.4.6, pg. 5-20 - **"There is potential for energy facilities to concentrate in areas abundant with the resource. In such areas, there is greater potential to contribute to cumulative depletion of water resources. Ground water depletion is not one of the issues addressed in the proposed lease stipulations, except indirectly through the requirement for compliance with applicable laws and regulations. The state engineer is responsible for assigning water rights and managing ground water resources..."**

PEIS Section CIOC pg. 5-26 - WHAT IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES WOULD BE INVOLVED WITH IMPLEMENTATION OF THE ALTERNATIVES? Section - **"... If any of the reasonably foreseeable development scenario facilities were to come on-line together in a resource area and were concentrated within a small geographical area, there could be some irreversible and irretrievable commitments of local geothermal resources"**... Under the Hydrology and water quality portion of this section - **"Because of the large volume and long duration of geothermal fluid production, the production stage of resource development is likely to have the greatest potential for impact to hydrologic resources. These impacts could occur in terms of changes to the hydraulics of the geothermal and ground water reservoirs and spent geothermal fluid disposal. Hydraulic head pressures in the geothermal and** C-26-15

adjacent ground water reservoirs could change during production. The result could include reduction in spring discharge rates and lowering of water levels in wells. Disposal of spent fluids by injection could also affect hydraulic heads and could introduce low-quality fluids to ground water pathways that discharge at springs or wells..."

Statements under PEIS Section CIOC pgs. 5-20 and 5-26 shown above demonstrate the need to address broader ranging water resource issues regarding protection of existing decreed geothermal water rights and resource users up-front within this PEIS. BLM and FS BMP's and procedures may vary from area to area, which ultimately creates confusion. Experience shows enforcement of BMP's is dependent upon dictates from Washington, D.C., which could potentially vary every four years. It is much more prudent, and it is the BLM and FS responsibility, to deal with the broader ranging water resource issues, primarily protection for existing geothermal water right owners and resource users, as part of this PEIS. In this manner, the BLM and FS will be minimizing the potential for negative impacts to the existing socioeconomic conditions in many of the communities which utilize the existing geothermal resources. In addition, this approach will ease some of the uncertainty faced by potential geothermal resource lease applicants and development companies.

I appreciate your consideration of the recommended inclusions for items 1), 2) and 3), as stated on pages 2 and 3 of this report, to the PEIS for Geothermal Leasing in the Western United States.

If you have any questions or comments please call.

Very Truly Yours,

MINION HYDROLOGIC

by Wayne Goin

Wayne E. Goin
Hydrogeologist

89-05/94-06/05-13(08)

cc: Dunton, LLC
Steve Johnson, Esq.
Orvis Hot Springs
Zach Miller, Esq.
Andy Mueller, Esq.
Wiesbaden Spa and Lodgings

C-26-1

Water impacts are better assessed at the local level due to variations in site-specific impacts. Prior to leasing, the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states typically manage and have regulatory authority for water quality, water rights, and wildlife. Site-specific impacts on water resources, including groundwater and water importation, would be addressed as part of the environmental analysis for the permitting process. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis, including public involvement, as appropriate. The BLM and FS would work with interested and affected parties to identify and resolve user or resource conflicts. Appropriate site-specific mitigation would be developed, as necessary.

C-26-2

Prior to leasing, the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states typically manage and have regulatory authority for water quality, water rights, and wildlife. Site-specific impacts on water resources, including groundwater and water importation, would be addressed as part of the environmental analysis for the permitting process. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis, including public involvement, as appropriate. The BLM and FS would work with interested and affected parties to identify and resolve user or resource conflicts, including impacts on existing geothermal water right owners and resource users. Appropriate site-specific mitigation would be developed, as necessary.

C-26-3

As discussed in Section 1.5.1, geothermal leasing is guided by law (e.g., Geothermal Steam Act) and regulations, including the recently revised geothermal leasing and development regulations (43 CFR 3000, 3200, and 3280). The PEIS is not proposing to amend or change any of the laws or regulations. Addressing site-specific issues is evaluated during the subsequent permitting process. The BLM and FS can apply conditions of approval on such permits to avoid and minimize any impacts to specific resources. While the BLM manages the geothermal resource (namely the heat), the state has primacy over the associated water resource. In accordance with state regulations, a lessee/operator must secure permits from the state before the BLM can issue a permit to drill either a temperature gradient well or a full-diameter exploration well.

C-26-4

As stated above, .site-specific impacts on water resources, including groundwater and water importation would be addressed as part of the environmental analysis for the permitting process. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis, including public involvement as appropriate. BLM and FS would work with interested and affected parties to identify and resolve user or resource conflicts. Appropriate site-specific mitigation would be developed as necessary.

C-26-5

As stated above, the PEIS is not proposing to amend or change any of the laws guiding geothermal leasing. Prior to leasing, the BLM or FS would collaborate with appropriate state agencies, as the BLM and FS recognize that states typically manage and have regulatory authority for water rights. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis, including public involvement, as appropriate. BLM and FS would work with interested and affected parties to identify and resolve user or resource conflicts. Appropriate site-specific mitigation would be developed, as necessary.

C-26-6

As stated above, site-specific impacts on water resources, including groundwater, would be addressed as part of the environmental analysis for the permitting process. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis, and the BLM and FS would work with interested and affected parties to identify and resolve user or resource conflicts. Appropriate site-specific mitigation would be developed, as necessary.

C-26-7

As stated above, site-specific impacts on water resources, including groundwater, would be addressed as part of the environmental analysis for the permitting process prior to development or utilization of the resource. Furthermore, as discussed in Section 1.5.1, geothermal leasing is guided by law (e.g., Geothermal Steam Act) and regulations, including the recently revised geothermal leasing and development regulations (43 CFR 3000, 32000, and 3280). The PEIS is not proposing to amend or change any of the laws or regulations.

C-26-8

The comment is noted.

As stated in Section 4-4, impacts of development, utilization, and reclamation of geothermal resources include the potential for groundwater contamination. Appendix D provides BMPs to address methods to minimize contaminations. Federal, state, and local regulations ensure that operators will conduct drilling in a prudent manner.

C-26-9

As stated above, site-specific impacts on water resources, including groundwater and water quality, would be addressed as part of the environmental analysis for the permitting process. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis. Appendix D provides BMPs to address methods to minimize water contamination. Federal, state, and local regulations ensure that operators will conduct drilling in a prudent manner.

C-26-10

See response to comment 1-2-4 and comment 1-2-6 for discussion of development of high steam areas.

Geological faulting depends on the geological characteristics of the area where the geothermal fluids are extracted, or where any other groundwater source used for cooling may be extracted. These conditions and the potential to impact them vary by location and by the proposed development. Prior to making leasing decisions, BLM will assess whether the existing NEPA is adequate (i.e., through completion of a DNA), or whether there is new information or new circumstances that warrant further analysis.

C-26-11

The comment is noted. There may be unique cases where testing could have an adverse impact; however, the intent of testing is to design a sustainable operation. Potential impacts to groundwater depend on many site-specific characteristics (e.g., soil type and fracturing). Potential for such impacts would be evaluated prior to subsequent development permits. In addition, as the commentor noted, water rights and state regulations also affect this issue.

C-26-12

As stated in responses above and discussed in Section 1.5.1, geothermal leasing is guided by law (e.g., Geothermal Steam Act) and regulations, including the recently revised geothermal leasing and development regulations (43 CFR 3000, 32000, and 3280). The PEIS is not proposing to amend or change any of the laws or regulations. Addressing site-specific issues is evaluated during the subsequent permitting process. The BLM and FS can apply conditions of approval on such permits to avoid and minimize any impacts to specific resources. While the BLM manages the geothermal resource (namely the heat), the state has primacy over the associated water resource. In accordance with state regulations, a lessee/operator must secure permits from the state before the BLM can issue a permit to drill either a temperature gradient well or a full-diameter exploration well.

C-26-13

As stated in Section 4-4, impacts of development, utilization, and reclamation of geothermal resources include the potential for groundwater contamination. Appendix D provides BMPs to address methods to minimize contaminations. Federal, state, and local regulations ensure that operators will conduct drilling in a prudent manner. Potential for contamination based on local soil types and groundwater conditions would be assessed prior to issuance of permits for development.

C-26-14

As stated above, site-specific impacts on water resources, including groundwater, would be addressed as part of the environmental analysis for the permitting process. BLM and FS would work with interested and affected parties to identify and resolve user or resource conflicts. Appropriate site-specific mitigation would be developed, as necessary.

As discussed in Section 1.5.1, geothermal leasing is guided by law (e.g., Geothermal Steam Act) and regulations, including the recently revised geothermal leasing and development regulations (43 CFR 3000, 32000, and 3280). The PEIS is not proposing to amend or change any of the laws or regulations.

C-26-15

The PEIS provides a standard set of BMPs for BLM and FS offices. Due to variations in local resources, the implementation of BMPs would necessarily be varied. As stated above, prior to leasing, the BLM or FS would collaborate with appropriate state agencies. Site-specific impacts on water resources, including groundwater and water importation, would be addressed as part of the environmental analysis for the permitting process. The BLM and FS would work with interested and affected parties to identify and resolve user conflicts, and appropriate site-specific mitigation would be developed, as necessary.

As discussed in Section 1.5.1, water rights are administered and adjudicated at the state level. Each prospective lessee-developer will be required to apply for and obtain an adjudicated state water right before actually attempting to recover geothermal resources (see Section 1.5.1).

SAGUACHE COUNTY GOVERNMENT

501 FOURTH STREET
SAGUACHE, COLORADO
AREA CODE 719 ZIP CODE 81149

September 2, 2008

BLM/Forest Service

To Whom It May Concern:

The Saguache County Board of County Commissioners are writing to inform you of our support for Alternative B – proposed action – concerning PEIS on Geothermal Energy on public lands. A-27-1

Alternative B – which will access all public and NFS land I the 12 Western states (in. Alaska) with geothermal potential as being open or closed to leasing for both direct (space heating and spas and indirect (electricity generation) use development use development; adopt a comprehensive list of stipulations, best management practices, and procedures to serve as consistent guidance for future geothermal leasing and development; amend BLM Resource Management Plans (RMPs) to adopt the reasonable foreseeable development scenarios (RFDs); and make decisions to issue or deny geothermal lease applications on BLM and NFS lands pending as of January 1, 2005.

Thank you for allowing Saguache County to comment on the proposed Geothermal Energy Development on public lands.

Sincerely,

Sam Pace
Chairman

Michael Spearman
Commissioner

Linda Joseph
Commissioner

A-27-1

The commentor’s preference for Alternative B is noted.

This message has been automatically forwarded from geothermal_eis@blm.gov.

mktolbert@cot.net
09/09/2008 09:00 AM

To geothermal_EIS@BLM.gov
cc
bcc
Subject Geothermal @ Medicine Lake

My husband and I are against geothermal in the Medicine Lake area. We have a cabin there and just live 30 miles due west in a small, beautiful, quiet town of Tennant, Ca. I can't understand why geothermal would even be considered in such a pristine area like Medicine Lake, especially when there is no significant amount of heat. I have yet to see why they even call it "green energy" because there is nothing "green" or clean about the way they produce it. Thank you for your time. Krista Tolbert I-28-1

I-28-1

The commentor's preference for no geothermal development in the Medicine Lake area is noted.

THE STATE OF ARIZONA
GAME AND FISH DEPARTMENT
5000 W. CAREFREE HIGHWAY
PHOENIX, AZ 85086-5000
(602) 942-3000 • WWW.AZGFD.GOV

September 4, 2008

Geothermal Programmatic EIS
c/o EMPSi
182 Howard Street
Suite 110
San Francisco, CA 94105-1611

Re: **Western Geothermal Programmatic EIS**

Dear Sirs:

The Arizona Game and Fish Department (Department) reviewed the Draft Programmatic Environment Impact Statement (PEIS) to evaluate Geothermal Leasing in the Western United States. The Department supports the Bureau of Land Management's (BLM) efforts in developing the PEIS and provides the following comments for your consideration.

The Department supports the development of alternative energies, such as geothermal, provided detrimental effects to wildlife and wildlife habitat are avoided. Potential impacts to wildlife and their habitats should be fully addressed and analyzed, as well as impacts associated with the loss of public use which includes wildlife dependent recreation. This PEIS should not negate the need for NEPA on individual projects, allowing the Department and the public the opportunity to review and comment on specific projects affecting public lands. A-29-1

Both the PEIS and individual project NEPA analyses should evaluate alternatives to using public land for geothermal power generation. Geothermal projects appear to eliminate all other public uses of multiple-use land, including wildlife habitat and public recreation. The PEIS should evaluate alternatives to using public land for geothermal energy generation such as supporting utility scale geothermal generation on private lands. If public lands are determined to be appropriate for utility scale geothermal development, suitable placement will be crucial in ensuring natural resource protection. The identification of inappropriate areas on BLM administered lands including those areas already identified as sensitive in BLM's Resource Management Plans (including Wildlife Habitat Areas, areas with wilderness characteristics, etc.) will aid in focusing geothermal development in the appropriate areas. The Department recommends the use of previously disturbed lands, BLM lands identified for disposal, and other less environmentally sensitive land for geothermal energy development. A-29-2

Further, the Department is concerned with any net loss of groundwater. Although the use of groundwater is not regulated by BLM or the U.S. Forest Service, we believe the use of water for geothermal leasing should be part of the analysis for a lease. A-29-3

The Department appreciates the opportunity to provide comments on the draft PEIS. For further coordination or questions regarding this letter, please contact me at (623) 236-7606.

Sincerely,

Ginger Ritter

Ginger Ritter
Project Evaluation Program Specialist, Habitat Branch

cc: Laura Canaca, Project Evaluation Program Supervisor
Dave Dorum, Habitat Program Manager, Region I
Rick Miller, Habitat Program Manager, Region II
Habitat Program Manager, Region III
Russ Engel, Habitat Program Manager, Region IV
Joan Scott, Habitat Program Manager, Region V
Russ Haughey, Habitat Program Manager, Region VI

AGFD # M08-06161248

A-29-1

The comment is noted. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis. This document does predict a general level of anticipated future geothermal development in BLM areas that have geothermal potential, but it is not intended to provide full analysis of all phases of development. There are several subsequent stages of decision making necessary to approve geothermal resource development, each with its own environmental compliance requirements, including public involvement, as applicable. This document covers only the land use planning and lease issuance stages.

A-29-2

This PEIS allocates areas as being available or closed to geothermal leasing. Stipulations have also been identified that would be applied to protect sensitive resources. Before issuing any leases, the BLM would conduct the necessary review to ensure that leasing would be compatible with the local land use plan and would comply with all applicable Federal, state, and local laws and regulations, such as Endangered Species Act Section 107 consultation and National Historic Preservation Act Section 106 consultation. As noted in Section 2.2.2, there are a variety of stipulations and BMPs that could be applied to protect sensitive issues and conditions.

A-29-3

Prior to leasing, the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states typically manage and have regulatory authority for water quality, water rights, and wildlife. Site-specific impacts on water resources, including groundwater and water importation, would be addressed as part of the environmental analysis for the permitting process. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis, including public involvement, as appropriate. BLM and FS would work with interested and affected parties to identify and resolve resource conflicts. Appropriate site-specific mitigation would be developed, as necessary.

SIERRA CLUB
FOUNDED 1892

Great Basin Group
Sierra Club
P.O.Box 8096
Reno, Nevada 89507

SIERRA CLUB
FOUNDED 1892

September 7, 2008

BLM Geothermal Programmatic EIS
c/o EMPSi
182 Howard Street, Suite 110
San Francisco, CA 94105

Dear BLM Representative:

This letter is in response for public comment on the draft PEIS for Geothermal Leasing in the Western United States, dated May 2008.

This letter is written on behalf of the Great Basin Group of the Sierra Club. The Great Basin Group has over 2500 Sierra Club members and spans northern and central Nevada, which includes undoubtedly the largest potential for geothermal energy of any state. Please accept our comments on the PEIS.

Volume I: Programmatic Analysis

The Great Basin Group, Sierra Club, supports the Preferred Alternative as outlined in Chapter 2. We agree with the list of areas designated as closed to geothermal leasing. O-30-1

Volume II: Chapter 14: Humboldt-Toiyabe National Forest/Battle Mountain District: Environmental Analysis for Pending Lease Application NVN 074289

The following comments address the single lease proposal in this PEIS for Nevada.

We support the Preferred Alternative as set forth in this chapter, **with the following changes and clarifications**. We note that a total of 320 acres of public land are contained in the lease area and that this is fairly small area of impacted public land. We feel that the scope of analysis and proposed action are commensurate with the scale of the project proposed by the lessee. O-30-2

p. 14-9 Lessee proposes less than 20 acres of disturbance if there is full buildout of a geothermal field which will produce about 12 MW. Power lines are not addressed here, but this seems to avoid O-30-3 a significant issue. Surely the agencies and the lessee know where the potential tie-ins are. Surely they can estimate what the total area of disturbances would be for transmission line structures which would allow tie-ins at the potential points. I suspect this total area may be significant in relation to the 10-20 acres envisioned for the plant itself. **Please supply justification for ignoring the probable transmission line impacts.**

p. 14-13 The text says "The NFS portion of the lease sites is within an Inventoried Roadless Area. Development in this area would be consistent with this designation as long as no new roads are constructed to access the sites." This statement is obvious, but what it does not say clearly is that no new roads will be constructed within this area to access the sites. The language leaves it very unclear whether new roads will, or will not, be allowed in the Roadless Area. **We support a clear position saying they will not be.** This, of course, would effectively prohibit development of the geothermal field out into the Roadless Area. We don't think that such development is possible without roads. Are we wrong? O-30-4

p. 14-15 Under "Alternative B (Proposed Action)", it says "Issuing leases for the proposed lease sites could indirectly result in the development of geothermal resources at the sites...." **We believe the use of "could" is too weak.** Surely the lessee is fairly sure of the geothermal potential -- otherwise why lease this public land? The PEIS should be examining cumulative impacts, including full development as envisioned by the lessee, as stated below. O-30-5

p. 14-23 We feel that the language of the first two sentences under "Impacts" is strange. Of course the act of leasing itself has no environmental impact. Why should this even be stated? Other such statements occur in this chapter -- **please eliminate them**. It simply is confusing to the reader. O-30-6

p. 14-29 Treatment of the sage grouse here may need to be redone if, before the final PEIS, the listing status of the sage grouse is changed. In line 8 on this page: should the text read "in cooperation with other agencies"? O-30-7

p. 14-29 The presence, or not, of the speckled dace should be established before the final PEIS and suitable mitigation measures proposed. O-30-8

Respectfully submitted,

David von Seggern

David von Seggern, Conservation Chair
Great Basin Group, Sierra Club

O-30-1

Thank you for your comment. The commentor's support for Alternative B is noted.

O-30-2

Thank you for your comment. The commentor's preference for Alternative B is noted.

O-30-3

The following text and references have been added to the Final PEIS to address transmission lines:

> Great American Energy plans to connect to the existing 29 kV line that parallels the highway and runs through the Darrough's fee lands. The 29 kV line connects to the Round Mountain substation on the 230 kV line. No additional transmission lines or routes are contemplated (Great American Energy 2008b).

O-30-4

The existing case law regarding the Roadless Rule is inconsistent. On August 12, 2008, the Wyoming District Court found the 2001 Roadless Rule violated NEPA and the Wilderness Act (State of Wyoming v. US Department of Agriculture). The District Court ordered the 2001 Roadless Rule "set aside" and "permanently enjoined." This order is subsequent to a 2006 California District Court ruling that set aside the 2005 State Petitions Rule and reinstated the 2001 Roadless Rule. The United States Justice Department, on behalf of the Department of Agriculture, has filed motions with both the Wyoming and California courts seeking adjustments of those courts' conflicting judicial orders. Neither the Wyoming nor California District Court rulings bar the Department of Agriculture from promulgating other roadless area regulations. To address this inconsistency, the PEIS includes the following Department of Agriculture Roadless Area Stipulation, "If future legislation or regulation change the roadless area designation, the restriction would be revised along with any appropriate environmental review." An appropriate NEPA review would be required prior to any changes to the Roadless Area Stipulation.

O-30-5

This language has been strengthened to "would likely."

O-30-6

This and other similar statements have been removed.

O-30-7

Text has been revised to read "in cooperation with other agencies."

O-30-8

Species-specific mitigation measures would be developed prior to ground-disturbing activities (exploration or development). NEPA analysis would be required prior to any ground disturbance that could affect the dace.

This message has been automatically forwarded from geothermal_eis@blm.gov.

"Lovelace, Bonnie" <BLovelace2@mt.gov>

09/10/2008 01:29 PM

To "'geothermal_EIS@blm.gov'" <geothermal_EIS@blm.gov>

cc

bcc

Subject Comments from Montana Department of Environmental Quality

Mr. Jack Peterson
Bureau of Land Management

RE: Geothermal Programmatic EIS

Dear Jack:

The Department of Environmental Quality would like to thank you for taking the time to meet with us in Helena prior to the public meeting. At the meeting you especially requested comments regarding the regulatory description for Montana in Volume III.

Your description is fine as far as it goes. The role of EPA in implementing the Underground Injection Control permits and the overall Clean Water Act descriptions are accurate. However, I would like to add a few regulatory descriptions in a table format (attached) that might prove useful. The permits for air emissions are dependent upon whether or not a system is closed. If there are no air emissions, of course, no permitting would be required. For water, likewise, there would need to be a discharge either to surface water or groundwater. In Montana, state groundwater discharge permitting may duplicate the UIC program to some extent. A-31-1

Thank you for the opportunity to comment.

Bonnie Lovelace
Director's Office
Department of Environmental Quality
406-444-1760

(See attached file: State Permits.doc)

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY
PERMITS AND APPROVALS

Table 1

Permit/Approval Name	Nature of Permit	Authority
Section 401 Water Quality Certification	Provides a review of potential adverse water quality impacts potentially associated with discharges of dredged or fill materials in wetlands and other waters of the U.S.	Section 401 of the Clean Water Act
MPDES Wastewater Discharge Permit	Permits the discharge of wastewater to waters of the state. There is also a requirement to look at a proposal's plans and specifications to determine if a permit is needed (MCA, 75-5-402)	Montana Water Quality Act (75-5-401 et seq., MCA)
General Discharge Permit for Stormwater Associated with Construction Activities	Permits construction and industrial activities that would result in the discharge of stormwater to waters of the state.	Montana Water Quality Act (75-5-401 et seq., MCA)
General Permit for Stormwater Discharges Associated with Industrial Activity	Permits construction and industrial activities for the Generation Plant that would result in the discharge of stormwater to waters of the state.	Montana Water Quality Act (75-5-401 et seq., MCA)
Air Quality Preconstruction Permit	Permit for the construction, installation and operation of equipment or facilities that may directly or indirectly cause or contribute to air pollution.	75-2-211, MCA : Preconstruction permit
Air Quality Operating Permit	Permit for the construction, installation and operation of equipment or facilities that may directly or indirectly cause or contribute to air pollution.	75-2-217, MCA: Operating permit
Prevention of Significant Deterioration Permit (PSD)	Permit when a major new source of air pollution is proposed to constructed or modified in an area designated as attainment or unclassified for an ambient or quality standard.	ARM 17.8.801 et seq.
New Source Review in Non-attainment Areas	Permitting for major new or modified sources of air pollution construction in or near areas that are designated as non-attainment for an ambient air quality standard.	ARM 17.8.901-906
Montana Joint Application: 310 Permit	Permits construction activities in or near perennial streams on public and private lands.	Montana Natural Streambed and Land Preservation Act (75-7-101 et seq., MCA)
Montana Joint	Allows construction activities within a	Montana Floodplain

Application: Floodplain Development Permit	designated 100-year floodplain.	and Floodway Management Act (76-5-401 through 406, MCA)
Montana Joint Application: 318 Authorization short-term turbidity	Authorizes short-term exemptions from certain surface water quality standards.	Montana Water Quality Act (75-5-318, MCA)
Public Water Supply Approval	Review of engineering plans and specifications for a new public water supply for more than 25 people daily for period of at least 60 days in a one year period.	75-6-112, MCA: Plan Review and Approval
Open Cut Permit (if new gravel sources are needed for the project)	Permit to excavate 10,000 cubic yards or more total aggregate from one or more pits regardless of surface ownership.	Open Cut Mining Act (84-4-401 et seq., MCA)

A-31-1

Thank you for your comment. Regulatory descriptions provided were reviewed for consistency with Appendix A.

From:	Mommy Jackson
To:	Zoe Ghali
Subject:	Geothermal Leasing Project Comment
Date:	Wednesday, September 10, 2008 4:16:20 PM

Subject: Geothermal Leasing Project Comment
To: geothermal_eis@blm.gov, Mommy Jackson <momjackson3@gmail.com>

To the Geothermal Leasing Project Board,

I would like to submit for comment to the Geothermal Leasing Project. I oppose the proposed site within the Willamette National Forest, North Santiam site. This would impact the areas drinking water source to 147,250 residents of Salem, 7,505 residents of Stayton and other towns along the North Santiam. It would also impact those whose wells are provided for from the aquifers located throughout this region. The Three Basin Rule was established in1976 by the Environmental Quality Commission to provide safe drinking water for the major populations of Oregon. Businesses, local governments, utilities, recreational representatives and the public worked together to establish the Three Basin Rule. I want this rule enforced. This would prohibit the Geothermal Project from discharging hazardous wastes, therefore denying the project to proceed in this region.

I-32-1

Dozens of species have successfully recovered given the careful and beneficial protections of the Endangered Species Act. This law protects the endangered species and protects the balance of nature and the environment. The impacts to the endangered species and the wildlife within this area from the proposed geothermal project are unacceptable. I want the Endangered Species Act enforced. It is not acceptable to sidestep the laws to bring this project to such a delicate environmental area!

I suggest that the geothermal projects be located in other sites that would not impact the environment to vital areas of resources in Oregon. The North Santiam Site within the Willamette National Forest area in unacceptable to me. This is my drinking water source.

Sincerely,

Irene Jackson

487 N. Myrtle Avenue

Stayton, Oregon 97383

503-769-6992

momjackson3@gmail.com

I-32-1

Lands designated as open to leasing are subject to existing laws, regulations, and formal orders. In complying with these laws, regulations, and orders, some of the open lands may not be available for leasing. Chapter 2 explains, under *Procedures Prior to Leasing*, that the BLM and FS would comply with the requirements of the Endangered Species Act, including determining if any listed or proposed threatened or endangered species, or critical habitat, is present on nominated lease parcels and may be affected by any decision to lease. Chapter 6 of the Final PEIS, in turn, explains that the agencies have determined that the decision to lease has no effect on listed species or critical habitat.

To provide further protection for threatened, endangered, and sensitive species, the BLM will impose an ESA stipulation (see Section 2.2.2) on all geothermal leases.

QUECHAN INDIAN TRIBE
Ft. Yuma Indian Reservation

P.O. Box 1899
Yuma, Arizona 85366-1899
Phone (760) 572-0213
Fax (760) 572-2102

September 10, 2008

Draft Geothermal Leasing PEIS
c/o EMPSi
182 Howard Street, Suite 110
San Francisco, CA 94105-1611

Dear Sir/Madam,

Thank you for notifying us of the Draft Programmatic Environmental Impact Statement for the Geothermal Leasing in the Western United States.

We have reviewed the document and have a few concerns that we believe should be taken into consideration, especially when projects are proposed within the Tribes' traditional land area. The Tribe, who was here prior to the arrival of the Spaniards or Europeans, had several villages scattered throughout what is now Arizona and California. The traditional land area of the Tribe encompasses the lands from Blythe, CA into Mexico and from Gila Bend, AZ to Ocotillo, CA. It is within this geographic area that resources were utilized and the Tribe lived. Plants, animals, landforms, water, and cultural resources must all be considered as they are all used together to tell the history of the Tribe. A-33-1

On page ES-7, it is stated that long-term loss of vegetation, habitat, and soil; short-term impact to ground water during drilling; and short-term increase in air emissions from drilling and construction activities are adverse impacts that are expected. The potential destruction of traditional plant gathering areas and clay sources located within the project areas is quite concerning to the Tribe. The potential for animals of traditional importance to the Tribe to leave the area due to loss of habitation is also concerning.

On page 2-41, it is mentioned that during the Phase One: Geothermal Resource Exploration that "surveys may require creating access using four-wheel drive vehicles, or by helicopters or on foot to areas with no roads or very poor roads." We are requesting that all access routes be surveyed for biological and cultural resources. Unless there is an established, paved road, all access routes need to be surveyed. A-33-2

Due to each geothermal project having the potential to encompass 350 acres, we are requesting that the clustering of these projects be prohibited. As mentioned previously, the Tribe has a large traditional land area with an extensive network of cultural resources and TCP's located within. With each project the Tribe faces the loss of their culture as impacts to cultural resources affiliated with the Tribe, as well as the spiritual landscapes in which they are located, are impacted. A-33-3

To alleviate the potential for impacts to cultural resources and/or spiritual landscapes we request to be consulted with at the inception of the project, prior to any plans being finalized. Experience has shown us that once the plans for a project are in place people are less open to discussing suggestions from us for mitigation. By contacting and consulting with the Tribe when the project is first proposed, it is our hope that we will be able to work through any potential concerns during the planning process. A-33-4

Thank you again for your notification. If you have any questions, please do not hesitate to call me at (760) 572-2423.

Sincerely,

Bridget Nash-Chrabascz

Bridget Nash-Chrabascz
Historic Preservation Officer/Archaeologist

A-33-1

All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis. This document does predict a general level of anticipated future geothermal development in BLM areas that have geothermal potential, but it is not intended to provide full analysis of all phases of development. There are several subsequent stages of decision making necessary to approve geothermal resource development, each with its own environmental compliance requirements, including public and tribal involvement, as applicable. This document covers only the land use planning and lease issuance stages.

As stated in PEIS Section 2.2.2 *Procedures Prior to Leasing*, the authorized officer for the BLM or FS will consult with Native American Tribal governments. Through consultation, the agencies would identify tribal interests and traditional cultural resources or properties that may be affected by the federal leases.

A-33-2

Any exploration activities that result in ground-disturbing activities would require permitting coordination with the local BLM or Forest Service office prior to being conducted.

A-33-3

Geothermal resources are typically concentrated in specific geographic areas; therefore, the BLM cannot prohibit clustering of leases. Prior to inclusion of a parcel(s) in a competitive lease bid, consultation would occur with the appropriate tribes and/or State Historic Preservation Officers.

A-33-4

As stated in PEIS Section 2.2.2 *Procedures Prior to Leasing*, the authorized officer for the BLM or FS will consult with Native American Tribal governments, Alaska Natives, and State Historic Preservation Officers prior to inclusion of a lease in a lease sale. Through consultation, the agencies would identify tribal interests and traditional cultural resources or properties that may be affected by the federal leases.

Geothermal Programmatic EIS
c/o EMPSI
182 Howard St. Ste 110
San Francisco, Ca. 94105

7 Sept. 2008

Public Comment on a draft interagency Programmatic Environmental Impact Statement (PEIS):

It is my firm conviction that the BLM & the Forest Service should withhold all geothermal leasing decisions until individual Environmental Impact Statements are completed for each of the specific areas that are contemplated for geothermal leasing nominations on 19 million acres of public lands. F-34-1

I write to ask you to exclude Mt. Shasta & the Medicine Lake Highlands from all geothermal leasing. F-34-2

Sincerely yours,

Faith M. Willcox
47 Junction Rd.
Westport, Me. 04578

F-34-1

It is not clear what the commentor is referring to by "specific areas that are contemplated for geothermal leasing nominations on 19 million acres…" For the programmatic document, the Proposed Action does not identify specific areas for leasing. The pending lease areas identified in Volume II consist of 19 leases in 7 geographic clusters. Volume II contains additional analysis for each of the pending lease applications and also tiers to the analysis in the PEIS.

Decisions for the pending lease applications will be contained in separate Records of Decision from the Decision for the Programmatic Document.

F-34-2

As described in Section 2.2.2 *Procedures Prior to Leasing*, prior to inclusion of a lease in a competitive bidding process, the BLM or FS would review the lease area for sensitive resources and provide the necessary stipulations to protect these resources. This review would include consultation with appropriate Native American Tribal Governments, as necessary.

Nevada Power.
nevadapower.com

Sierra Pacific™
sierrapacific.com

Submitted electronically via e-mail
Friday, September 12, 2008

September 11, 2008

Geothermal Programmatic EIS
c/o EMPSi
182 Howard Street, Suite 110
San Francisco, CA 94105

Whom It May Concern:

Nevada Power Company and Sierra Pacific Power Company (the Companies), subsidiaries of Sierra Pacific Resources serving communities of southern and northern Nevada and a portion of California, appreciate the opportunity to review and provide comments to the Draft Programmatic Environmental Impact Statement (PEIS) for Geothermal Leasing in the Western United States. The Companies understand the goals of the PEIS are to amend land use plans to facilitate geothermal leasing decisions C-35-1 in an environmentally responsible manner, and does not authorize any ground-disturbing activities to explore for or develop geothermal resources. The Companies appreciate and support the planning criteria for this action that includes, "*Environmental protection and energy production are both desirable and necessary objectives of sound land management practices and are not to be considered mutually exclusive priorities.*" The Companies hereby provide some comments and questions related to this action.

The Companies have a three-part energy strategy to meet an overall goal of providing clean, safe, reliable electricity to their customers at reasonable and predictable prices. This strategy includes increasing energy efficiency and conservation programs, expanding renewable energy initiatives and investments and also involves a diversified energy portfolio with a balanced mix of fuels for energy generation. This is in the best interest of their customers, shareholders, the communities they serve and the state.

Nevada is composed of over 85% federal lands, with over 50% of these federal lands managed for conservation of specific natural resources (DOE, 2007). Some of the potential commercially viable renewable energy resources (i.e., solar, wind, geothermal) in Nevada are constrained by access, land conservation boundaries and military ground and air restrictions. Specific to geothermal leasing and resource development, non-discretionary closures regulated by Executive Orders, laws and C-35-2 regulations such as the Geothermal Steam Act of 1970 (GSA), as amended (30 USC, Section 1001) and the Geothermal Resources Leasing Rule (GRLR; 43 CFR 3201.10 and 3201.11), identify federal lands that are available and not available for geothermal leasing, further constraining the potential development of this resource for commercial electrical generation and direct use.

In the PEIS, it is not quite clear in Section 2.2.1, pages 2-6 and 2-7, how many acres of land are proposed to be closed for geothermal leasing over what is already unavailable by such orders, laws and regulations stated above (i.e., the baseline condition). The Companies interpret the nine bullets listed on page 2-6 as non-discretionary closures of federal lands that *"are excluded from geothermal leasing on the basis of existing laws, regulations and Executive Orders."* This seems to be the baseline condition (i.e., Alternative A: No Action). **Of the 142 million acres of federal BLM land identified in Table 1-1, how many acres are currently closed under the baseline condition from these existing laws?** C-35-3

The Companies interpret the six bullets on page 2-7 as proposed closures, separate from the existing closures described above, on federal BLM land under Alternative B: Proposed Action of the PEIS. **Table 2-1 on pages 2-8 and 2-9 shows a total of 25 million acres as "proposed closed". Do the 25 million acres listed in Table 2-1 include both the existing baseline closures plus the proposed action closures? If so, the Companies request further clarification to this point to show the two separate acreage amounts under Alternatives A and B.** C-35-4

The bullets on page 2-7 reference a list of ACECs that are currently open and closed to fluid mineral leasing. The list, found in Appendix C, includes ACEC designations that are currently not authorized yet by Records of Decision for local land use plan revisions (e.g., Stillwater ACEC in Winnemucca RMP). Table 2-3, page 2-26 states that this PEIS will have a Record of Decision prior to completion of Records of Decision for these as land use plans are still under revision. **If an ACEC has been proposed, but not yet authorized, what is BLM's approach to this issue?** C-35-5

Table 2.5 on page 2-30 shows a comparison of two of the three alternatives; however, Alternative A is not included. This makes it confusing to evaluate the two action alternatives against the baseline no action alternative, especially if the Companies' interpretation of the baseline condition, as described above, is correct. **The Companies request that the Agencies include acreage allocations under Alternative A in Table 2-5 to facilitate a more complete evaluation of the three alternatives.** C-35-6

The Companies feel this is a significant point to clarify, as it apparently seems that Alternative A would have the least amount of acres that would be closed for geothermal leasing, whereas Alternative B would progressively add to the closed acreage amount and Alternative C would have even more acres closed.

Section 2.2.3 on page 2-26 lists one rationale for amending existing land use plans as, "*the land use plan does not allocate areas as being open or closed to geothermal leasing*"; however, there are Executive Orders, laws and regulations (see Section 2.2.1) which designate lands as open or closed (i.e., Alternative A: No Action). **Are the land use plans required to be amended in order to incorporate existing orders, laws and regulations?** C-35-7

On page 2-26, there are four reasons given as to why some land use plans within the project area are excluded from amendment under the PEIS. Reasons (2) and (3) state that previously amended plans adequately address geothermal leasing and development, and plans currently being amended will address geothermal leasing and development. This appears to present a situation where applicants and project proponents will still experience inconsistent processing of applications as not all land use plans will have the same policies between field offices. **What criteria were used to determine that existing land use plans excluded from the PEIS "*adequately address geothermal leasing and development*"? Do these previous and currently amended land use plans also contain the same stipulations, Best Management Practices and procedures of this PEIS as proposed in Section 2.2.2? Or are they less or more rigorous? How does this PEIS support consistency in the processing and authorizing of geothermal leasing and development applications between field offices under this situation where land use plans will not be the same?** Future leasing approvals between field offices will inevitably have varied stipulations as well as mitigation and reclamation measures. C-35-8

Section 2.3.1, the No Action Alternative, on page 2-30 contains two paragraphs that appear to be contradictory to each other. The first paragraph states that no land use plans would be amended, and that no lands would be identified as open or closed to geothermal leasing. As previously stated already in the PEIS (see Section 2.2.1), existing orders, laws and regulations identify federal lands as open or closed, whether or not existing land use plans do the same. The 2nd paragraph correctly describes the no action alternative, simply that all new geothermal leasing applications would be handled on a case-by-case basis, with independent review under NEPA and other laws, as well as amendments to local land use plans as needed. So essentially, under Alternative A, land use plans would most likely be amended, but only as specific projects are proposed and would most likely not be consistent with plan amendments between field offices. The PEIS would be clearer to understand if there was a more thorough description and comparison represented in Alternatives A and B. C-35-9

Alternative C, as described in Section 2.3.3 on page 2-31, obviously limits utilizing the vast potential geothermal resources across the project area based on locations of existing transmission lines. There is no relation to the locations of existing transmission lines with all of the potential geothermal resource locations. Furthermore, this alternative does not address any future transmission lines not yet planned or proposed over the coming decades through, at a minimum, the 1) State of Nevada Governor Jim Gibbons' Nevada Renewable Energy Transmission Access Advisory Committee task force, and 2) the Department of Energy's Westwide Corridor Programmatic Environmental Impact Study. This alternative severely reduces the potential to tap into much of the geothermal resources in the west, and does not adequately serve the need to meet Section 211 and 222(d)(1) of the Energy Policy Act. The Companies do not support this alternative. C-35-10

The 2nd paragraph on page 4-5 states a figure of "*676,000,000 acres in the western U.S.*" to support a disturbance calculation in the preceding paragraph; however, this figure includes land outside the scope of the planning area of this PEIS and therefore reflects an inaccurate representation of disturbed land under the Reasonably Foreseeable Development scenario (RFD). According to Table 2-5 and Section 4.2.2, the correct figure to use should be 248,672,710 acres of BLM and FS lands in the planning area. C-35-11

In Chapter 4, the various resource sections with the sub-heading, "*Impacts under Alternative A*" do not appear to be consistent between themselves, or with the description of Alternative A as given under Section 2.3.1 on Page 2-30. For example, Section 4.2.4 on page 4-6 states, "*…all federal lands…would be open to geothermal leasing unless closed based on existing land use plans or congressional designation*" whereas Section 4.3.4 on page 4-22 states, "*…public lands would be designated as open or closed...by the individual field offices and ranger districts*" and further makes a new statement not seen in the PEIS until this point, "*Some field offices have developed resource management plans that standardize leasing approvals and operational stipulations for the field office planning area, reducing the need for case-by-case decision making. In other cases, geothermal leasing for direct and indirect use would continue to be approved on a case-by-case basis.*" Section 4.8.4 on page 4-55 states, "*…BLM…and FS…would continue to update their RMPs and forest plans, respectively, at their own pace*". The Companies request that Alternative A be consistently described throughout the PEIS to avoid confusion, and to more specifically identify the differences compared to Alternative B. C-35-12

The cumulative impacts on Energy and Minerals as described in Section 5.4.3 on page 5-19 contain the following statements: "*An increase in development of geothermal resources would have a cumulative impact of reducing the demand for nonrenewable energy. Based on the RFD, there is the potential to triple the megawatts produced with geothermal resources, which would offset power demand from coal, oil and gas.*" These statements assume that demand for electricity remains relatively constant, which will probably not be the case throughout the electrical service territories within the project area; especially in Nevada which continues to be the fastest growing state in the nation. Given that geothermal projects are small and can take years to permit, explore, design and construct, the cumulative impacts described in this section may need to be reconsidered. Over half the nation's current electricity generation is derived from fossil fuels (i.e., coal, gas and oil) and many experts believe this trend will continue for at least the next few decades. C-35-13

Best Management Practices (BMP)

The BMPs listed in Appendix D is an exhaustive list of measures. The Companies understand and include as a normal course of practice in project design and planning, efforts to avoid natural resources to the greatest extent practical, and where avoidance is not practical, mitigating activities to reduce impacts within non-significant C-35-14 levels. This is a fair and common sense approach to ensure safety of crews and equipment during construction and operation, as well as ensuring environmentally sound measures in conserving resources. However, the BMPs as presented in the PEIS by activity (i.e., Exploration, Drilling, Utilization, and Reclamation) appear to be redundant, contradictory and some of which are part of other processes in the federal right-of-way application process (see below).

Page D-3, 3rd bullet: this is already required under NEPA and not necessary to specify as a BMP
Another example is the varied BMPs for access roads, as follows:

- *Existing roads should be used to maximum extent feasible* (p. D-3)
- *The project shall be planned to utilize existing roads…to the maximum extent practicable* (D-3)
- *Existing road shall be used, but only if in safe and environmentally sound locations* (D-5; Please define what is meant by "environmentally sound locations")
- *Access roads shall be surfaced with aggregate* (D-5)
- *Access roads shall be located to follow natural contours and minimize side hill cuts* (D-5)
- *Roads shall be designed so that changes to surface water runoff are avoided* (D-5)
- *Road use shall be restricted during the wet season* (D-5)
- *Access roads shall be located to minimize stream crossings* (D-6)
- *Roads shall be located away from drainage bottoms and avoid wetlands* (D-6)
- *Existing roads should be used to the maximum extent feasible* (D-9)
- *If new access roads are necessary, they should be designed and constructed to the appropriate standard* (D-9)
- *Existing or new roads should be maintained to the condition needed for facility use* (D-9)
- *Existing roads should be used to the maximum extent feasible* (D-10)
- *New access roads should be configured to avoid high-quality habitats and minimize habitat fragmentation* (D-10)
- *Site access roads should minimize stream crossings* (D-10)

A project proponent can easily become confused with this inconsistent list of varied requirements just for access roads. A reader's first reaction is to assume access roads cannot be built anywhere with all of these restrictions listed as BMPs. Project proponents understand the technical feasibility of siting, designing, constructing and/or maintaining roads from a civil engineering perspective to ensure that the equipment and materials planned for the project can safely be transported across such road; and from an environmental impact perspective, understand the natural resources present that can be avoided and/or mitigated to the extent feasible. The Companies suggest more consistent description and applicability of BMPs.

Some BMPs don't seem to be feasible; for instance,"*Existing sites shall be used in preference to new sites*" is included under Exploration, Drilling, Utilization and Reclamation. Obviously the Agencies copied most, if not all, of the exact same BMPs into each activity section. From a practical standpoint, using existing sites for each of the four activities is not appropriate and in fact, does not help to meet the goal of increasing geothermal energy generation on federal lands in the project area. The Companies understand that the BMPs are intended to be a laundry list that individual field offices would draw from in selecting appropriate measures for specific projects; however, the experiences the Companies have had are that field offices do not have the personnel or the time to utilize this approach and typically an entire generalized list of measures are included in right-of-way grants issued for projects. The Companies feel that close coordination between project proponents and the federal agency on site-specific projects should warrant site-specific measures based on the environmental analyses to avoid confusion, allow for an efficient implementation of projects and give specific and clear direction to project proponents. C-35-15

The Companies appreciate this opportunity to submit comments on the PEIS and look forward to continuing to participate in this process to help find responsible, fair and common sense solutions to geothermal leasing and development on the federal lands in the western states.

Sincerely,

Eileen Wynkoop
Manager, Environmental Services

Citations

U.S. Department of Energy, Draft Programmatic Environmental Impact Statement, *Designation of Energy Corridors on Federal Land in the 11 Western States* (DOE/EIS-0386). October 2007.

C-35-1

Thank you for your comment. The comment is noted.

C-35-2

The comment is noted.

C-35-3

The non discretionary closures are lands that are currently closed based on laws and regulations and are therefore part of the baseline condition. The baseline condition also includes discretionary closures as identified by specific local land use plans for geothermal resources. Some land use plans have made such allocations, but many plans have not made discretionary allocations for geothermal leasing, and as such, are inadequate to make leasing decisions. This means that lands within these planning areas are neither open nor closed to leasing until a formal land use plan amendment is undertaken. Because many plans do not have allocations for leasing, it is not possible to provide baseline acreage of open or closed areas. As stated in Section 1.2, *Purpose of the Action*, the Proposed Action seeks to amend all inadequate plans and bring consistency to the leasing process.

C-35-4

The six bullets are the proposed discretionary closures for BLM lands. Most existing land use plans that address geothermal leasing include these six types of closures. The acreage in Table 2-1 accounts for both the non-discretionary and discretionary closures under the Proposed Action (Alternative B). As noted above, it is not possible to classify and calculate acres for the baseline (Alternative A: No Action), because of the non-allocated status of most BLM lands for geothermal leasing.

C-35-5

Appendix C has been revised to only include existing ACECs. ACECs that are part of an ongoing land use plan revision will be allocated as open or closed for leasing as part of the planning effort.

C-35-6

As noted above, it is not possible to classify and calculate acres for the baseline (Alternative A: No Action), because of the non-allocated status of most BLM lands for geothermal leasing.

C-35-7

All public lands are managed in accordance with laws, regulations, and orders. Plans do not have to be amended to incorporate the laws. Plans are reviewed to ensure that the decisions within the plans are still consistent with any new laws, regulations, or orders.

C-35-8

Differences in the way that land use plans address geothermal leasing and development are a necessary outgrowth of localized characteristics of the resources in the planning area. Language has been added to Section 2.2.3 to clarify this.

C-35-9

The first paragraph states what would occur as part of this process if No Action is taken; hence, no plans would be amended and no allocations would be made. Existing laws and regulations are part of the baseline, so taking No Action does not change that condition.

The second paragraph is correct in that it provides the current process for handling lease applications. BLM has added some clarifying language to the first paragraph.

C-35-10

The commentor's concerns with and lack of support for Alternative C are noted.

C-35-11

This figure is an accurate number for lands managed by the BLM and the FS in the Western US, as stated in the sentence. The intent of this statement was to demonstrate that the total amount of disturbed land is small compared to the total amount of public and NFS land in the west.

C-35-12

"Impacts under Alternative A" has been revised for consistency for all resource sections.

C-35-13

While demand for electricity may increase in the future as noted in this comment, the increase in development of geothermal resources would decrease the amount of this electricity that must be obtained from nonrenewable sources.

C-35-14

The BMP appendix has been revised to increase readability and decrease redundancy.

C-35-15

The intent of the referenced BMP is that other disturbed sites (e.g., an oil and gas facility or mining site) would be used if possible, not necessarily that the same site be used between geothermal development phases.

At the programmatic level, a specific list of applicable BMPs cannot be developed that would fit the wide diversity of conditions found within the Western US. The BMPs are meant to be a general list that can be used proactively by lessees in preparing their permit applications or would be included in the approved use authorization by the BLM as conditions of approval. As noted in the introduction section of the appendix, the list is not all inclusive, and other BMPs can be developed by applicants and the BLM. The introduction also highlights the importance of the dialogue between the BLM and applicants in determining the appropriate BMPs for a given activity.

Helene Murawski, R.N.
P. O. Box 1386
Mt. Shasta, CA 96067
September 10, 2008

Geothermal Programmatic EIS
C/o EMPSI
182 Howard Street, Suite 110
San Francisco, CA 94105

Attn: Jack Peterson

I am writing to you about the leasing of public lands for the use of Geothermal projects. What I'm especially concerned with is The Medicine Lake and it's high-lands. A pristine mountain lake, recreation area and park.

People come from miles around to enjoy the pristine beauty of the lake and surrounding mountain. Part of the beauty is that you have to go for miles to get to it. One of the reasons it's so pristine .

Local Native American tribes revere the lake as a healing grounds and sanctuary. A sacred place. A place to rest and relax in such special surroundings. I-36-1

Also people live the summer months there and enjoy the fresh air, clean water, and sporting. A lot of people enjoy this place. Without industrialization. Without pollution.

So why spoil this place of beauty? So a select few corporate hooligans can make a big profit? And any placement of geothermal works in the area won't benefit anyone or any-thing at Medicine Lake .

I'm against the streamlining of the leasing process for geothermal projects in the Medicine Lake Highlands and the Mt. Shasta area. Streamlining the leasing process is akin to cheating on an exam. You don't really have to study and it's allowing someone to get away with something they don't deserve.

Not only are the projects large, ugly and polluting, their noisy drill rigs, lighting and pipelines will impact water, air and other natural habitats. Plus what about the dangers associated with geothermal power like blowouts, and runaway wells spewing hydrogen sulfide gas in the atmosphere and killing everything within 10 miles.

Geothermal projects industrialize an area. Why would you want to make an area as pristine as Medicine Lake Highlands into an industrial wasteland while trying to make money for a corporation. Stop the industrial-exploitation of Medicine Lake.

Sincerely,

H Murawski, R.N.

Helene S. Murawski R.N.

I-36-1

As described in Section 2.2.2 *Procedures Prior to Leasing*, prior to inclusion of a lease in a competitive bidding process, the BLM or FS would review the lease area for sensitive resources and provide the necessary stipulations to protect these resources. This review would include consultation with appropriate Native American Tribal Governments as necessary.

The resource uses compatible with geothermal use are likely to vary depending on site-specific conditions. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis, including public involvement, as appropriate. The BLM and FS would work with interested and affected parties to identify and resolve user or resource conflicts. Appropriate site-specific mitigation would be developed, as necessary.

Bureau of Land Management and Forest Service
Geothermal Leasing in the Western United States Draft PEIS

We encourage you to provide your comments by filling out and submitting this comment form ***by September 19th, 2008.*** Please fax your completed form to 1-866-625-0707 or mail it to the address on the opposite side. You are also welcome to e-mail your comments to: geothermal_eis@blm.gov

Your Name WILLIAM L. D'OLIER Date 12 September 2008
Mailing Address 310 Hume Lane City/State/Zip Bakersfield CA 93309
Telephone (optional) 661 832 9592 E-Mail Address (optional) gepca@sbcglobal.net
Would you like to be added to this project's mailing list to receive future project-related information?
Yes ☑ No ☐
Please indicate your affiliation by checking **one** of the following boxes:
☑ Individual (no affiliation) ☐ Private Organization ☐ Citizen's Group
☐ Federal, State, or Local Government ☐ Elected Representative ☐ Regulatory Agency

Name of organization, government, group, or agency (if applicable)____________

The BLM and FS want to hear from you! Please provide your comments on the Draft PEIS in the space below.

Having examined the 3-volume Draft PEIS and attended the Sacramento Public Meeting on 30 July 2008, I want to thank the BLM and FS for their joint effort to expedite leasing, exploratory drilling and development of geothermal resources on the federal mineral estate. Regarding former public lands conveyed into private surface ownerships, it is encouraging that the BLM deems these subsurface federal mineral rights to be available for Geothermal Leasing. C-37-1

From its oil, gas and geothermal leasing experience the BLM knows that greater complications and higher costs/risk attach to divided surface vs. mineral ownerships on any land parcel or leased area. PEIS Vol. I indicates the BLMs intent to use the nomination/competitive bid process to offer federal mineral leases under private lands. While this path would ease Geothermal Leasing workload for BLM, it promises two negative impacts. It could deflect the interest of qualified geothermal explorers/developers, particularly those pursuing geothermal electric grade targets. It could diminish BLM responsibility to enable the discovery of significant economic values even in the lesser inventory of isolated federal mineral estate tracts. C-37-2

I would request BLM's consideration of an additional path or option to approach prospects burdened by severed surface and federal mineral estates. This concept might best be called an exploratory drilling agreement, to be proposed by a qualified venture group (QVG).

The QVG would negotiate with BLM to expeditiously drill/flow test, at QVG's cost/risk, a geothermal reservoir target below 6000' depth. This deep, full hole exploratory well is to be accomplished within 5 years of the federal GT lease issue date. QVG would meet all leasing, environmental and permit costs. An integrated post-drilling report would compare well results vs. the pre-drilling basis for the target tested and be provided to BLM at no cost. C-37-3

I would urge the BLM to add this "initiative option" as an appropriate additional tool to tackle the more complex exploration challenge posed when only isolated federal mineral estate is offered for Geothermal Leasing.

Respectfully,

Wm L. D'Olier

William L. D'Olier
Geothermal Consultant and
Professional Geologist, CA Lic.

C-37-1

Thank you for your comment.

C-37-2

The comment is noted.

C-37-3

This is outside the scope of the PEIS.

geothermal_eis

From: Mary_Christensen@blm.gov [Mary_Christensen@blm.gov] **Sent:** Mon 9/15/2008 8:42 PM
To: geothermal_eis
Cc:
Subject: Mail forwarded from geothermal_eis@blm.gov
Attachments:

This message has been automatically forwarded from geothermal_eis@blm.gov.

Alex Sifford <alexs@oregoncoast.com> To geothermal_eis@blm.gov
cc
09/15/2008 09:41 PM bcc
Subject Geothermal PEIS

Hello,
This communication is to voice support the Alternative B: Proposed Action as the Preferred Alternative to the Geothermal Programmatic EIS undertaken by the BLM.
1. The PEIS Alternative B is very reasonable and allows geothermal development only on lands legally open to geothermal leasing and subject to existing laws, regulations, formal orders, stipulations. C-38-1
2. The PEIS preferred Alternative will benefit not only geothermal but other renewable resources such as wind and solar energy on BLM lands. Alternative C, which limits development to a 20-mile corridor from existing transmission lines, could limit development of those renewable resources as well.
Thank you for the opportunity to comment.
Regards
Alex Sifford

Sifford Energy Services
PO Box760/ 48390 Breakers BlvdNeskowin, OR97149-0760503.392.3965 t
541.992.2956 calexs@oregoncoast.com

C-38-1

The commentor's support for Alternative B is noted.

geothermal_eis

From:	Mary_Christensen@blm.gov [Mary_Christensen@blm.gov]	**Sent:**	Mon 9/15/2008 8:34 PM
To:	geothermal_eis		
Cc:			
Subject:	Mail forwarded from geothermal_eis@blm.gov		
Attachments:			

This message has been automatically forwarded from geothermal_eis@blm.gov.

Patricia Simmons
<psimmons@imt.net>
To: Geothermal_EIS@blm.gov
cc:
09/15/2008 09:33 PM
bcc:
Subject: Protect Yellowstone, Ensure Responsible Geothermal Energy Development
Please respond to psimmons@imt.net

All energy projects need to be located in areas that do not damage national parks or other wild places valued for their wildlife habitat, recreation and hunting opportunities, and stunning natural beauty. Stay away from Yellowstone National Park! C-39-1

Patricia Simmons
1123 Woodland Drive
Bozeman, MT 59718-2767

C-39-1

Leasing is not permitted in Yellowstone National Park or any National Park System Units. Prior to inclusion of any specific parcels in a lease sale, the BLM and FS would coordinate with the National Park Service to determine if there would be any impacts to thermal or hydrological features within NPS units in proximity to a proposed lease. Language has been added to Section 2.2.2 *Procedures Prior to Leasing* to reiterate this point.

In addition, should development be determined to be reasonably likely to have an "adverse effect" on a significant thermal feature, the BLM would include appropriate lease stipulations to protect the park unit.

If it is determined in advance of leasing that exploration, development, or utilization of the lease parcel would "reasonably likely result in a significant adverse effect on a significant thermal feature of a National Park System unit," then the lease would not be issued (30 USC Section 1026(c)). While preexisting leases and permits are beyond the scope of this PEIS, the statute also provides that, if it is determined that use of an existing lease or permit would be "reasonably likely to adversely affect" any significant thermal feature within a National Park System unit, then stipulations are included on leases and permits to protect the thermal features (30 USC Section 1026 (d)).

geothermal_eis

From: Mary_Christensen@blm.gov [Mary_Christensen@blm.gov] **Sent:** Tue 9/16/2008 6:27 AM
To: geothermal_eis
Cc:
Subject: Mail forwarded from geothermal_eis@blm.gov
Attachments:

This message has been automatically forwarded from geothermal_eis@blm.gov.

Nancy Wedow <nvwedow@sbcglobal.net>
To: Geothermal_EIS@blm.gov
cc
09/16/2008 07:24 AM
bcc
Subject: Protect Yellowstone, Ensure Responsible Geothermal Energy Development
Please respond to nvwedow@sbcglobal.net

Renewable energy development is a critical part of the solution to the challenges facing our nation?s energy future. However, all energy projects need to be located in areas that do not damage national parks or other wild places valued for their wildlife habitat, recreation and hunting opportunities, and stunning natural beauty. F-40-1

We can ensure that geothermal energy is developed intelligently and responsibly as long as proper siting is a key part of the equation. Please insure the Final Geothermal Energy Plan is consistent with the following:

* Yellowstone National Park?s geothermal features must be fully buffered from geothermal leasing outside the park?s boundary ? including full protection of the Yellowstone Controlled Goundwater Area, the Island Park Geothermal Resource Area, and a fifteen-mile buffer along other park boundaries. F-40-2

*Geothermal development should be prohibited in roadless areas, important wildlife habitat, and all areas that have been specially designated to protect their natural values. F-40-3

*All lands proposed for wilderness designation, including citizen-proposed F-40-4 wilderness and Wilderness Study Areas, should be excluded from consideration. When necessary the agencies should inventory lands to confirm the existence of wilderness characteristics and then remove them from geothermal consideration.

*Besides avoiding sensitive and special wildlands, the agencies should prioritize geothermal projects that are in already degraded lands or in proximity to existing or planned energy corridors. The agencies should avoid redundant or overly extensive transmission lines and co-site geothermal projects with solar energy projects when possible as a means for reducing the energy footprint on our public lands. F-40-5

Guiding industrial geothermal development to those areas where it is most appropriate and will have the least impact on wild land values will ensure a win for both our public lands and our energy needs.

Nancy Wedow
228 N. Middleton
Palatilne, IL 60067

F-40-1

The comment is noted. Stipulations, best management practices, and procedures have been added in the PEIS to provide protection for other resources and resource uses.

F-40-2

Given that impacts on geothermal resources from adjacent development may vary based on site-specific conditions, no specific buffer zone has been established for NPS lands.

Island Park Geothermal Areas is designated as a non-discretionary closure (see Section 2.2.1).

F-40-3

This PEIS allocates areas as being available or closed to geothermal leasing. Stipulations have also been identified that would be applied to protect sensitive resources. Before issuing any leases, the BLM would conduct the necessary review to ensure that leasing would be compatible with the local land use plan and would comply with all applicable Federal, state, and local laws and regulations, such as Endangered Species Act Section 107 consultation and National Historic Preservation Act Section 106 consultation. As noted in Section 2.2.2, there are a variety of stipulations and BMPs that could be applied to protect sensitive issues and conditions.

F-40-4

Decisions regarding the management of areas with wilderness characteristics are made at the field office level as part of the local land use planning process and not in this PEIS. This allows wilderness characteristics to be evaluated at a finer scale than afforded at a programmatic level. The management and level of protection of the wilderness characteristics on non-WSA lands is discretionary and not bound by requirements of the Wilderness Act of 1964 or the WSA Interim Management Policy (IMP, H-8550-1; BLM 1995); thus, these areas have no official status that removes them from consideration for leasing. Nonetheless, the BLM must consider in its NEPA analyses possible impacts on wilderness characteristics, if present, and may manage the lands to protect and/or preserve some or all of those characteristics through the local land use planning process.

As noted in Chapter 2 of the Draft PEIS, before making any leasing decisions, the BLM will assess whether the existing NEPA documentation is adequate (i.e., through completion of a DNA), or whether there is new information or new circumstances that warrant further analysis. For example, additional NEPA analysis may be required in light of new information or from a potential change in management approach regarding resources identified for special management (e.g., travel management planning or areas under consideration by BLM for management for wilderness characteristics).

F-40-5

Citing of leases in relation to transmission lines or solar projects is outside the scope of this PEIS. There are several subsequent stages of decision making necessary to approve geothermal resource development, each with its own environmental compliance requirements, including public involvement, as applicable. This document covers only the land use planning and lease issuance stages.

Before issuing any leases, the BLM would conduct the necessary review to ensure that leasing would be compatible with the local land use plan and would comply with all applicable Federal, state, and local laws and regulations, such as Endangered Species Act Section 107 consultation and National Historic Preservation Act Section 106 consultation.

Contact Information
San Juan Public Lands Center
Gary Thrash (gthrash@blm.gov) or Matt Janowiak (Matthew_Janowiak@blm.gov)
15 Burnett Ct.
Durango, Colorado 81301

Comment-Number 2008-001

Chapter: 2.5.1 RFDs for Electrical Generation (Indirect Use) Table 2-7 Page: 2-39

Document Section: Table 2-7 Commercially Viable Geothermal Capacity for Electrical Generation by High Potential Area and Associated BLM Field Offices and National Forests O-41-1

Associated National Forest Column lists San Juan(Poncha), Gunnison (Pagosa,

Comment: Pagosa Hot Springs should be San Juan NF not Poncha

Comment-Number 2008-002

Chapter: 2.2.1 Identify Lands for Leasing Page: 2-6

Document Section: The BLM and FS have determined that certain lands within the planning area are excluded from geothermal leasing on the basis of existing laws, regulations (see 43 CFR 3201.11), and Executive Orders. These non-discretionary closures O-41-2

Comment: Needs to be clarified with section 1.9.1 Programmatic Scope which does not list National Monuments, NCA's.

Comment-Number 2008-003

Chapter: 2.2.1 Identify Lands for Leasing Page: 2-7 O-41-3

Document Section: 75 million acres of NFS lands would be open by statute to leasing.

Comment: Clarify what statute?

Comment-Number 2008-004

Chapter: 2.2.2 Lease Stipulations, Best Management Practices, and Page: 2-15

Comment-Number 2008-005 O-41-4

Document Section: Applicability of Stipulations Stipulations provided in this PEIS would serve as the minimal level of protection and would be adopted into local land use plans upon signing of the ROD. For example, if an administrative unit has eligible wild and scenic rivers, the wild river stipulation would apply. If an existing land use plan offers more protective measures or has resource specific commitments (e.g., memorandum of understanding for cultural resources), those more protective measures would

Comment: Need to confirm list of plans that would change,.

Comment-Number 2008-005

Chapter: 2.2.3 Amend BLM Land Use Plans Page: 2-23

O-41-5

Document Section Table 2-3 Land Use Plans Proposed for Amendment under the PEIS

The rationale for amending these plans includes the following:
• The land use plan does not address geothermal leasing.
• The land use plan does not allocate areas as being open or closed to geothermal leasing.
• The land use plan does not assess the reasonably foreseeable development scenario for geothermal development, or the analysis requires updating.
• The land use plan does not have adequate or appropriate stipulations or best management practices to apply to geothermal leases to protect sensitive resources.

Comment San Juan/San Miguel Plan is not listed in this table. Should it be?

Pg 2-26 to 2-27 Do Criteria for plans excluded from amendment under this PEIS apply? (3) the plan currently is being amended or revised in a separate NEPA review and that amendment or revision will address geothermal leasing and development. The BLM anticipates that the analyses contained in this PEIS would be incorporated into those amendments and revisions, as appropriate.

Include of a table with plans that meet this criteria.

Comment-Number 2008-006

Chapter: 2-30 Draft PEIS for 2.3 ALTERNATIVES Page: 2-30

O-41-6

Document Section Table 2-5 Comparison of Geothermal Resource Allocations between the Action Alternatives

Comment For both Alternatives B & C: Acreages do not add up for Public lands open to indirect use + Public Lands Closed to Indirect use = Public Lands in Planning Area. Same for Indirect Use.141,671,723 vs 142,188,175

Comment-Number 2008-007

Chapter: 3.4 ENERGY AND MINERAL RESOURCES Page: 3-34

O-41-7

Document Section Statement: Oil, Gas and Geothermal leasing is guided by the Energy Policy Act of 2005.

Comment Should the references be the Mineral Leasing Act of February 25, 1920; Geothermal Steam Act of 1970 (30 U.S.C. 1004)
As amended by the Energy Policy Act of 2005.

Comment-Number 2008-008 O-41-8

Chapter: Appendix E. Review of Paleontological Resource Sections of Page: E-10

Document Section Table E-1 Review of RMPs and PFYC Estimates

Comment Table lists an RMP in Colorado that does not exist: San Juan Silverton August 2004 .
2004 document was a plan amendment for the San Juan/San Miguel RMP to permit a developed ski Area.

Comment-Number 2008-009 O-41-9

Chapter: Draft PEIS for Geothermal Leasing in the Western US 3-47 Page: 3-47
Comment-Number 2008-010

Document Section Paleontological sensitivity maps based on the PFYC are available for only two of the affected states: Colorado and Utah. **These are appended to provide**

Response Checked for maps in appendix. Not found.

Comment-Number 2008-010 O-41-10

Chapter: 3.7 WATER RESOURCES AND QUALITY Page: 3-84

Document Section Surface Water. In southwestern Colorado, summer monsoonal flow produces…

Comment: Not always true. Recent drought years have not had significant monsoonal moisture.

Comment-Number 2008-011 O-41-11

Chapter: 3.14 Cultural Resources Page: 3-163

Document Section Appendix I provides detailed discussions of the prehistoric and historic cultural resources and patterns of these regions.

Comment Maps of tribal areas reflect more recent cultures. Question is on how Puebloan cultural attachments to SW Colorado are addressed in this document. Seems to be a lack of discussion on the importance of the Anasazi cultures in SW Colorado and our Field Offices are not identified in Appendix I pages 54;
Maps show current tribal distribution but do not recognize significance of ancestral puebloan occupation in SW Colorado. Revise description of Cultural Areas to indicate Southwest Cultural Area extending through 4 corners area of Colorado and to reflect the significant use of this area by the Puebloan cultures.

Comment-Number 2008-012

Chapter: 3.14.7 Southwest Page: 3-175 O-41-12

Document Section	The Southwest culture region covers all of Arizona, the western majority of New Mexico, the southern tip of Nevada, southern Utah, extreme southern and western Texas, and parts of southwest Colorado (Figure 3.21 – Southwest Tribal Ranges). Within the project area, the Southwest culture region includes portions of FS Regions 2 and 4 and all of Region 3 and all or portions of the western BLM Field Offices.
Comment	Southwest cultural region should encompass portion of southwest Colorado with significant prehistoric cultural resources as typified by Mesa Verde & Hovenweep National Parks and Canyons of the Ancients National Monument. Figure 3.21 using historic tribal ranges does not adequately recognize this resource.

Comment-Number 2008-013

Chapter: Appendix I. Cultural Resource Regional Ethnohistory Page: I-54 O-41-13

Document Section	SOUTHWEST Cultural Region. The USFS regions included in the Southwest region include portions of Regions 2 and 4 and all of Region 3. BLM Field Offices in the region include all or portions of all field offices in New Mexico and Nevada with the exception if the Arizona
Comment:	Dolores Field Office and Canyons of the Ancients National Monument should be reflected in this Cultural region. Figure numbers in Appendix I do not correspond to Figures in chapter 3 of Volume I.

O-41-1

The change was made as suggested.

O-41-2

Section 1.9.1 lists lands that are closed to geothermal leasing by statue. Non-discretionary closures included in Section 2.2.1 *Lands Identified for Leasing*, include lands closed by law, regulation, and executive orders. Details of closures are included in Section 4.2. *Land Use, Recreation, and Special Designation*.

O-41-3

The sentence has been revised to read as follows:

> In addition, 75 million acres of NFS lands have been identified as not being closed by statute, regulation, or orders, and as such, would be open for evaluation for leasing.

O-41-4

See list of plans to be amended in Table 2-3.

O-41-5

The San Juan/San Miguel Plan has been added to the list of plans for amendment.

O-41-6

Table 2-5 has been revised.

O-41-7

The following text has been inserted:

> Geothermal Steam Act of 1970 (30 USC 1004), as amended by the Energy Policy Act of 2005.

O-41-8

Thank you for your comment. The RMP mentioned has been deleted.

O-41-9

Data for the Appendix are provided in tables, not maps. References to maps have been removed.

O-41-10

The text in Section 3.7 has been amended as follows:

> Precipitation varies greatly with location and elevation and from year to year. Droughts of several years have been known to occur. The precipitation occurs in the form of winter snows and heavy autumn rainstorms. In southwestern Colorado, summer monsoonal flow generally produces ample rain in non-drought years.

O-41-11

In all cases, broad-scale figures are provided for illustrative purposes for the PEIS. The commentor is correct that the regional maps reflect the territories of more recent cultures and that any boundaries shown could be debated on the basis of past occupations, linguistic ties, oral histories, archaeology, and cultural influences. A consistent, standard source, the volumes of the Smithsonian Handbooks of North American Indians, was used for the maps in this generalized overview. Clearly Ancestral Puebloan sites are present throughout the southwest in territories assigned to non-Puebloan groups and further into Colorado than may be implied by the figure. Tribal consultation would not be limited by these boundaries. Clarifying text was added to Section 3.14.

O-41-12

See response to comment O-41-11 above.

The overviews and maps provided are not designed to be a comprehensive source for information on resources or the extent of cultural influence. There would be follow-on work to identify resources and consultation required to address any site-specific lease applications.

Mesa Verde & Hovenweep National Parks and the Canyon of the Ancients National Monument are closed to application.

O-41-13

The text has been changed to include all southern Colorado field offices.

Figure numbers have been revised.

Oregon Natural Desert Association

VIA E-mail (geothermal_eis@blm.gov) without enclosure and First Class Mail with enclosure

September 17, 2008

Jack G. Peterson
Bureau of Land Management – Geothermal PEIS
c/o EMPS, Inc.
182 Howard Street, Ste 110
San Francisco, CA 94105

Re: Draft Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States

Dear Mr. Peterson:

Please accept these comments from the Oregon Natural Desert Association ("ONDA") on the interagency Draft "Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States" ("DPEIS"). ONDA is a non-profit public interest organization O-42-1 dedicated to preserving and protecting the public lands of eastern Oregon. ONDA has a long history of interest and involvement in eastern Oregon's public land management. ONDA's mission is to protect, defend, and restore forever the health of Oregon's native deserts. The members and staff of ONDA use and enjoy the public lands, waters, and natural resources within the project area for recreational, scientific, spiritual, educational, aesthetic, and other purposes. ONDA and its members also participate in information gathering and dissemination, education and public outreach, commenting upon proposed agency actions, and other activities relating to the federal government's management and administration of the public lands of eastern Oregon. Our comments on the DPEIS focus on the effects of the proposed action and alternatives in the State of Oregon.

ONDA recognizes the potential importance of geothermal energy and other alternative sources of low-carbon-emission energy for reducing this country's reliance on fossil fuels and beginning to reverse the effects of global climate change. However, renewable "green" energy is not truly "green" if it results in the careless or thoughtless sacrifice of other resources on our public lands. Reasonable development of geothermal energy begins with a carefully-considered scheme of leasing, which identifies and protects, from the PEIS stage, lands and resources which should be sheltered from the most destructive consequences of energy development. ONDA is concerned that the DPEIS is not adequate to support a decision to designate lands for geothermal leasing because it fails to analyze sufficient alternatives, does not adequately evaluate the wilderness characteristics of the lands that would remain open to leasing or on the wildlife and plants for which these lands are important habitat, lacks analysis of impacts from foreseeable projects within the project areas under the various alternatives, and contains inadequate assessment of the cumulative impact of opening up to 192 million acres of public lands to geothermal leasing in conjunction with dozens of energy production and transmission projects currently under development or on the drawing board throughout the West.

The result is a draft programmatic environmental impact statement that is too limited in its evaluation of impacts to the environment from the proposed action. Despite the proposal to facilitate the process for leasing geothermal resources on up to 192 million acres of land managed by the Bureau of Land Management ("BLM") and U.S. Forest Service ("Forest Service"), the agencies have not adequately evaluated the effects that leasing and subsequent development of geothermal resources would have on listed and sensitive species and their habitat. Nor does the DPEIS assess whether there are alternatives or combinations of closed lands or protective buffer zones that could significantly decrease the detrimental effects of future geothermal power projects on wildlife and wild lands and yet still allow for development of this important alternative energy source in appropriate locations.

I. The Agencies Must Consider More Than Two Alternatives in the Final PEIS.

The DPEIS considers only the proposed action and an alternative ("Alternative C") which would limit leasing to lands within 10 miles each side of existing transmission lines, together with a "no action" alternative that is not given serious considation.[1] NEPA requires that federal agencies provide a detailed evaluation of alternatives to the proposed action in every NEPA document. 42 U.S.C. § 4332; 40 C.F.R. § 1502.14(a). This discussion of alternatives is essential to NEPA's statutory scheme and underlying purpose. See, e.g., Bob Marshall Alliance v. Hodel, 852 F.2d 1223, 1228 (9th Cir. 1988), cited in Alaska Wilderness Recreation & Tourism Ass'n v. Morrison, 67 F.3d 723, 729 (9th Cir. 1995); Muckleshoot Indian Tribe v. U.S. Forest Serv., 177 F.3d 800, 813 (9th Cir. 1999). Indeed, NEPA's implementing regulations recognize that the consideration of alternatives is "the heart of the environmental impact statement." 40 C.F.R. § 1502.14. Pursuant to this obligation"[a]n agency must look at every reasonable alternative, with the range dictated by the nature and scope of the proposed action." N.W. Envtl. Defense Ctr. v. Bonneville Power Admin., 117 F.3d 1520, 1538 (9th Cir. 1997). Because of the vast expanse and variety of lands and resources which would be affected by the proposed leasing, limiting the alternatives considered to two action alternatives is inadequate to satisfy NEPA. O-42-2

The purpose of the PEIS is to consider the effects on the environment of potential exploration and development of geothermal resources throughout the West. Because the DPEIS contemplates that additional, site-specific environmental analysis may *not* occur, DPEIS at 1-26, it is incumbent upon the agencies to conduct a comprehensive review of alternatives and affected resources at the programmatic level. The proposed alternative ("Alternative B") makes the vast majority of the lands considered in the DPEIS available for leasing without adequate analysis or protections for sensitive resources. O-42-3

[1] The "no action" alternative is described as a "baseline" against which the two action alternatives are measured, rather than a genuine alternative. DPEIS at 2-30. O-42-2

The agency's obligation in its environmental review is to "[r]igorously explore and objectively evaluate all reasonable alternatives" in order "to restore and enhance the quality of the human environment and avoid or minimize any possible adverse effects of [the agency's] actions upon the quality of the human environment." 40 C.F.R. §§ 1502.14(a), 1500.2(f). Analysis of alternatives must be "sufficiently detailed to reveal the agency's comparative evaluation of the environmental benefits, costs and risks of the proposed action and each reasonable alternative." Id. The agencies should prepare a set of genuine reasonable alternatives that include several different configurations which would designate fewer lands for geothermal leasing, that identify lands which could be leased without controversy, such as those already degraded or located immediately adjacent to existing transmission lines, and that consider phased development of geothermal resources based on a hierarchy of protection for sensitive species habitat and preservation of wilderness values. The alternatives should focus more attention than the DPEIS currently does on limiting the area available for geothermal leasing to protect sensitive areas of the public lands and the creatures that live on them. Where site-specific decisions are being made in a programmatic EIS—such as here, where large but distinct areas of land are being segregated for potential leasing without further environmental review—and potentially designating different and more limited areas is a reasonable alternative, considering only two alternatives is inappropriate under NEPA. See, e.g., IlioUlaokalani Coalition v. Rumsfeld, 464 F.3d 1083, 1096-01 (9th Cir. 2006). O-42-3

II. The Agencies Should Undertake a Comprehensive Environmental Analysis Before Opening Public Lands to Geothermal Leasing.

Though the DPEIS, the agencies are planning to designate millions of acres of public land as open to geothermal leasing. The agencies accordingly should use the PEIS process to undertake a comprehensive review of the potential that geothermal energy development has for fragmenting important wildlife habitat and eliminating wilderness values throughout the West. In addition, BLM, which administers the majority of federal land where leasing would occur, has a substantive duty to ensure that the decision complies with the multiple use mandate in the Federal Land Policy and Management Act ("FLPMA"). This includes FLPMA's unnecessary or undue degradation and "without permanent impairment" provisions, the Section 603 nonimpairment duty, and the duty to act consistently with BLM's land use plans (which contain standards, goals, objectives, etc. for wildlife, habitat, and other values/resources associated with wilderness). The practical result is that this PEIS presents the proper occasion for a full assessment of the impacts to wilderness, wildlife, plant life, and the cultural, scenic, and historic values of the lands on which geothermal leasing may occur. Comprehensive analysis of these factors is necessary to properly assess—and minimize—the effects of future projects on the environment. O-42-4

As discussed further below, wilderness values, wildlife, and largely-intact native ecosystems could be threatened by geothermal exploration and development. In eastern Oregon, any project developed away from the immediate vicinity of existing road or energy transmission infrastructure has the potential of impairing intact roadless areas which contain some of the remaining strongholds for shrinking populations of sage grouse and pygmy rabbits, and which serve as important habitat for pronghorn, bighorn sheep, and native plant species. The PEIS must fully analyze the wilderness values of these lands where geothermal exploration or development would inevitably lead to roadbuilding or associated transmission projects that could eliminate their wildness forever.

In addition to the proposed consultation with FWS and NOAA Fisheries (the "Services") related to species listed under the Endangered Species Act, the presence in the proposed action area of significant habitat for other sensitive species warrants evaluation in the PEIS and consultation with the Services. Development of geothermal resources could further fragment habitat that is necessary to ensure the survival of sage grouse and pygmy rabbits, two species that are currently under review for listing as threatened or endangered. Only through consultation with FWS during the preparation of the PEIS can the agencies make an informed decision about whether the lands they might designate as open for leasing appropriately minimize potential harm to these and other sensitive species from future geothermal energy projects. Once the lands have been opened to leasing, it will be too late to comprehensively assess whether geothermal exploration and development will have undue impacts on these species at the landscape and habitat level.

III. Impacts of the Proposed Action on Roadlessness and the Wilderness Resource.

The proposed action covers all public lands managed by the agencies in Oregon east of the Willamette Valley. The high desert lands east of the Cascade Mountains include some of the most important remaining intact habitat for Greater sage grouse, pygmy rabbits, and pronghorn, O-42-5
along with large tracts of Forest Service and BLM lands that remain roadless and retain wilderness characteristics. Because of the remarkable concentration of wilderness-quality land and relatively unspoiled wildlife habitat in this region, ONDA urges the agencies to develop alternatives that would close public lands that retain roadless or wilderness characteristics to geothermal leasing.

Under the Roadless Area Conservation Rule ("Roadless Rule"), a "road may not be constructed or reconstructed in inventoried roadless areas of the National Forest System." 36 C.F.R § 294.12(a); 66 Fed. Reg. 3,244, 3,270 (Jan. 12, 2001). The Forest Service promulgated the rule in large part to protect the values and characteristics of these roadless areas from adverse impacts caused by road construction, road reconstruction and road use. These values and characteristics include high quality or undisturbed soil, water and air; sources of drinking water; diverse plant and animal communities; habitat for special status species; scenic beauty; reference landscapes; locally identified unique characteristics; cultural properties, and recreation. 36 C.F.R. § 294.11 (defining Roadless area characteristics).

The DPEIS recognizes that road construction or reconstruction would be necessary for exploration, drilling, and development phases of geothermal energy production. DPEIS at 2-40 to 2-46. Because construction of roads in inventoried roadless areas is prohibited under the Roadless Rule, the agencies must include inventoried roadless areas among the National Forest System lands closed to geothermal leasing.

The DPEIS also acknowledges that BLM has the *authority* to consider the effects of the proposed action on the wilderness resource even on lands that have not formally been designated O-42-6
as wilderness or as Wilderness Study Areas. DPEIS at 1-25. However, a recent court decision makes clear that BLM's has certain *obligations* to identify and manage lands for the protection

of wilderness characteristics. Under FLPMA, BLM must inventory public lands and resources on a continuing basis. 43 U.S.C. § 1711(a). As the U.S. Court of Appeals recently held, wilderness and roadlessness are resources for which BLM must keep a current inventory. Ore. Natural Desert Ass'n v. BLM, 531 F.3d 1114, 1119, 1138 (9th Cir. 2008).[2] Having inventoried lands with wilderness or roadless characteristics, BLM then must provide for the management of these wilderness and roadless resources in its land use plans, and consider "whether, and to what extent, wilderness values are now present in the planning area outside of existing WSAs and, if so, how the Plan should treat land with such values." Id. at 1143.

The U.S. District Court for the District of Oregon has held that impacts to such proposed wilderness areas must be considered in conducting environmental impact evaluations under NEPA. The court held that the BLM "was obligated under NEPA to consider whether there were changes to or additions to the wilderness values within [the project area], and whether the proposed action in that area might negatively impact those wilderness values, if they exist." Ore. Natural Desert Ass'n v. Rasmussen, 451 F. Supp. 2d 1202, 1213 (D. Or. 2006). The court enjoined a BLM decision to develop grazing infrastructure within the project area until the agency had completed its inventory of wilderness values, requiring BLM to inventory wilderness values and prepare a valid NEPA document that considers the impact of the proposed action on wilderness characteristics. Similarly, leasing for geothermal exploration and development cannot proceed until BLM has ensured that it has an up-to-date inventory of lands with wilderness characteristics and until BLM has evaluated the impacts of geothermal exploration and development on those lands.[3]

Because the Geothermal PEIS is intended to amend up to 122 land use plans, BLM should conduct the required inventory and protection of lands with wilderness characteristics as part of this planning process, and close lands with wilderness characteristics to geothermal leasing to protect this essential public resource. This planning process should result in BLM evaluating information previously obtained from citizen groups for proposed wilderness designation, and, based on that information, BLM should include citizen-proposed wilderness areas and other lands with wilderness characteristics among the lands closed to geothermal exploration and development.

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[2] In addition to roadlessness, "wilderness characteristics" include naturalness and providing opportunities for solitude or primitive recreation. Ore. Natural Desert Ass'n v. BLM, 531 F.3d at 1137.

[3] Litigation is currently pending in federal courts against the Department of the Interior concerning impacts to wilderness values in many areas in eastern Oregon where citizen-proposed wilderness areas are at issue and where BLM has not adequately inventoried wilderness characteristics—for example, Ore. Natural Desert Ass'n v. BLM, No. 05-35931 (9th Cir.) (regarding the South Eastern Oregon RMP), Ore. Natural Desert Ass'n v. Shuford, No. 06-242 (D. Or.) (regarding the Andrews-Steens RMP), Ore. Natural Desert Ass'n v. Gammon, No.07-35728 (9th Cir.) (regarding the Lakeview RMP), Ore. Natural Desert Ass'n v. Freeborn, No.06-1311 (D. Or.) (regarding the Louse Canyon GMA), in addition to administrative appeals over several other projects and plans.

ONDA has previously submitted five sets of citizen inventories and proposed Wilderness Study Areas to BLM's district offices in Oregon. These inventories are as follows: O-42-7

September 2002:	Andrews Resource Area (Steens) Wilderness Inventory
November 2002:	Supplement to Andrews Resource Area Wilderness Inventory
February 2004:	Vale District Wilderness Inventory
April 2005:	Lakeview District Wilderness Inventory
September 2007:	Three Rivers Resource Area Wilderness Inventory

The map at Exhibit 1 below (originally prepared to illustrate areas of potential wind power development) provides the most current overview of the location of these proposed Wilderness Study Areas, marked on the map as "roadless areas." With the hard copy of these comments, ONDA is enclosing a CD-Rom containing detailed maps of each citizen-proposed Wilderness Study Area contained in these submissions, the reports that accompanied the submissions, and GIS layers corresponding to the proposed Wilderness Study Areas. The lands depicted on the enclosed maps contain wilderness characteristics, and BLM should close these lands to leasing for geothermal exploration and development.

IV. Impacts of the Proposed Action on Wildlife and Plant Habitat

Part of the process of developing a PEIS that accurately assesses the west-wide impacts of designating areas for geothermal leasing is early and comprehensive consultation with fish and wildlife management agencies on the impacts to listed and candidate species from the exploration and development that is almost certain to occur on some of these leased lands. Although specific impacts from particular projects will still need to be analyzed at the project level, a comprehensive assessment at the programmatic level will ensure that leasing is allowed only on lands that will minimize detrimental effects to plant and animal habitats. O-42-8

This is of particular concern in the sage-steppe environment of eastern Oregon and other interior western states, where fragile lands and species that depend on them are already seriously threatened by chronic overgrazing, increasing pressures from oil and gas development, and growing threats from destructive wildfires, drought, and climate change. Because of its relative remoteness and lack of development, eastern Oregon remains a stronghold for several species which are federally protected or are being considered for federal protection.

Eastern Oregon is one of the largest relatively intact sections of sage-steppe habitat remaining in the West. The public lands on and surrounding the proposed Hart Mountain and Beaty Butte WSAs comprise a significant, critical swath of habitat linking Hart Mountain National Antelope Refuge to the northwest to Sheldon National Wildlife Refuge in northern Nevada, and connecting with designated wilderness and WSAs to create a corridor to Steens Mountain to the northeast. The area supports a vast array of wildlife, and includes critical winter and migratory habitat for pronghorn, as well as important habitat for sage grouse, pygmy rabbits, Western big-eared bats, ferruginous hawks, burrowing owl, desert and short-horned lizards, and countless other birds and mammals. The neighboring Hart Mountain and Sheldon refuges are unique in that they comprise the largest area in the Great Basin no longer grazed by livestock.

This area is the heart of the proposed Sage Grouse National Conservation Area, depicted in the map in Exhibit 2. The Greater sage grouse population has declined as much as 45–80 percent over the past 20 years due to habitat destruction, degradation and fragmentation, with the current breeding population estimated at 140,000 individuals, representing only about eight percent of historic numbers. A 2004 survey by state and federal scientists found that sage grouse are in long-term decline, with the report concluding it was "not optimistic about the future of sage-grouse because of long-term population declines coupled with continued loss and degradation of habitat and other factors (including West Nile Virus)."[4] Sage grouse depend on unbroken, healthy expanses of sagebrush habitat such as that present within the proposed Sage Grouse NCA.

Recognizing that Oregon is an area of critical importance for the species's survival, Oregon's Department of Fish and Wildlife ("ODWF") has adopted a conservation strategy for the sage grouse,[5] underscoring that human activities and structures decrease the quality of sage grouse habitat and can result in habitat loss and direct bird kills. The strategy, at pages 83–84, recommends that land management agencies carefully evaluate actions that could lead to harm to sage grouse habits. Specifically, new energy development and associated transmission projects "should avoid surface occupancy within 3.2 km (2 mi) of known/occupied sage-grouse habitat" and follow "existing utility corridors and rights-of-ways to consolidate activities to reduce habitat loss, degradation, and fragmentation by new construction." If geothermal energy projects and their associated transmission lines could not be built immediately adjacent to existing transmission lines, ODWF recommends that planners "seek to minimize disturbance to known breeding, nesting, and brood-rearing habitats by placing power line corridors >3.2 km from these areas." ODWF's strategy highlights the importance of preserving habitat integrity and connectivity, noting that

O-42-9

> Habitat loss and fragmentation are probably the 2 leading causes for the long-term decline in sage-grouse. Current and future land management will need to examine landscape patterns of sagebrush habitat and seek strategies to ensure that large connected patches of sagebrush are present. The implementation of the connectivity model and habitat monitoring techniques suggested in the Plan will help minimize the impacts of habitat loss and fragmentation.

Greater Sage-Grouse Conservation Assessment and Strategy for Oregon at 84.

Similar guidance, stressing the importance of maintaining intact habitat, is found in the BLM's National Sage Grouse Habitat Conservation Strategy and BLM's guidelines regarding Special Status Species such as sage grouse.

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[4] Connelly, J. W., S. T. Knick, M. A. Schroeder, and S. J. Stiver. 2004. Conservation Assessment of Greater Sage-grouse and Sagebrush Habitats. Western Association of Fish and Wildlife Agencies. Unpublished Report. Cheyenne, Wyoming.

[5] Oregon Department of Fish & Wildlife, Greater Sage-Grouse Conservation Assessment and Strategy for Oregon: *A Plan to Maintain and Enhance Populations and Habitat*, available at http://www.dfw.state.or.us/wildlife/sagegrouse/.

In December 2007, the U.S. District Court for the District of Idaho ordered the FWS to evaluate properly whether the Greater sage grouse should be listed as threatened or endangered under the Endangered Species Act. The FWS has begun its new review of the sage grouse's status. Federal agencies proposing actions as significant as designating millions of acres of public lands as open to geothermal leasing must be particularly careful that their decisions do not have adverse impacts on species whose status is so precarious that they may be listed under the ESA. This is particularly true in light of the well-documented and devastating effect that oil and gas development has had on sage grouse populations in the Rocky Mountain states. Because the agencies have analogized geothermal energy leasing and development to oil and gas development, DPEIS at 2-6, and noted similar effects, it is particularly important that the agencies tread carefully when deciding which lands within their jurisdiction should be opened to new energy development. O-42-10

The agencies' discussion of the sage grouse in the DPEIS at 3-139 to 3-140 and 4-81 to 4-85 does acknowledge that geothermal energy projects are likely to harm sage grouse, recognizing that the birds need contiguous, undisturbed areas of high-quality habitat, and that geothermal exploration rigs and production facilities, associated transmission lines, pipelines, and access roads may adversely affect habitats important to sage grouse by causing fragmentation, reducing habitat value, or reducing the amount of habitat available. Power plants, transmission lines, pipelines, and other structures can also provide perches and nesting areas for raptors and ravens that may prey upon gallinaceous birds. However, the information about the potential harm to sage grouse does not actually inform the agencies' decision of what lands should be leased for geothermal energy development, and whether there are alternatives that would avoid disrupting the "contiguous, undisturbed" sage grouse habitat present throughout southeastern Oregon.[6]

Without consultation with FWS regarding sage grouse, and the absence of alternatives that might designate certain lands—for example, all lands within 3.2 km of known sage grouse leks—as closed to leasing to protect sensitive species habitat, the DPEIS contains no adequate analysis of the effects of the proposed action alternative on sage grouse and other sagebrush-dependent wildlife. The agencies have a duty to consider "cumulative effects" under NEPA, and consider alternatives—such as closing essential sage grouse habitat to geothermal leasing—that would preserve the relatively intact sage-steppe habitat in this area.

The project area in eastern Oregon is also habitat for pygmy rabbits. On January 8, 2008, the U.S. Fish & Wildlife Service announced a positive 90-day finding on a petition to list the pygmy rabbit under the ESA, beginning the listing review process. Pygmy rabbits, like sage grouse, are dependent on large areas of intact sage-steppe habitat for their survival. Any activities that fragment pygmy rabbit habitat—including exploration and development of geothermal energy—could lead to increased pressure on the species and its continued existence. As a result, the PEIS should include consultation with FWS on the status of the pygmy rabbit, and the potential impact of geothermal exploration and development on the rabbit and its habitat. O-42-11

[6] The discussion also appears to omit a text box or figure, no. "4.10-1," that is referenced elsewhere in the text. <u>See, e.g.</u>, DPEIS at 3-140, 4-67, 4-78, 4-81. O-42-10

O-42-1

The comment is noted.

O-42-2

In accordance with 40 CFR Section 1502.13, the purpose of and need for the proposed action is used to define a range of reasonable alternatives (purpose of and need for action is defined in Sections 1.2 and 1.3). The BLM is making an allocation decision here, and adopting a list of stipulations, BMPs, and compliance procedures to be incorporated in the land use plans. The PEIS analyzes in detail the Proposed Action, a No Action alternative, and the Leasing Near Transmission lines alternative. The Final PEIS incorporates input from public comments on the Proposed Action. Another alternative considered but eliminated from detailed study included no leasing or development of geothermal resources on public or NFS lands (Section 2.4.1). As explained in Section 2.4.1, this alternative, which would have been most protective (from a ground disturbance standpoint), was eliminated because it would violate the multiple use provisions of FLPMA and is inconsistent with the President's National Energy Policy, the Energy Policy Act of 2005, and Executive Order 13212 and would not have fulfilled the purpose and need for the proposed action.

The alternatives analyzed represent a range of acreages as potentially available for leasing. See CEQ's *Forty Most Asked Questions Concerning the CEQ's NEPA Regulations*, Question 1b ("When there are potentially a very large number of alternatives, only a reasonable number of examples, covering the full spectrum of alternatives, must be analyzed and compared in the EIS."). In particular, the Leasing Near Transmission Lines alternative was developed based on public scoping comments to represent a limited development alternative. Instead of inventing a variety of alternatives that would lie between the alternatives presented, the BLM and FS elected to include protective measures (i.e., stipulations, BMPs, and compliance procedures) in each of the action alternatives. Further, those planning areas whose plans include more protective measures may elect to keep those measures in place, instead of the stipulations, BMPs, and compliance procedures presented in the Final PEIS.

O-42-3

See response to comment O-42-2, above.

O-42-4

The analysis in Chapter 4 is commensurate with the scope of the proposed action for the PEIS.

All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis. This document does predict a general level of anticipated future geothermal development in BLM areas that have geothermal potential, but it is not intended to provide full analysis of all phases of development. There are several subsequent stages of decision making necessary to approve geothermal resource development, each with its own environmental compliance requirements, including public involvement, as applicable. This document covers only the land use planning and lease issuance stages.

0-42-12

0-42-13

0-42-14

The PEIS designates lands as open to geothermal leasing subject existing laws, regulations, and policies that may result in decisions to not lease or to lease with stipulations, terms, or conditions. O-42-15

O-42-5

The existing case law regarding the roadless rule is inconsistent. On August 12, 2008, the Wyoming District Court found the 2001 Roadless Rule violated NEPA and the Wilderness Act (*State of Wyoming v. US Department of Agriculture,* 07-CV-17-B, Wyoming District Court, Cheyenne, Wyoming [2008]). The District Court ordered the 2001 Roadless rule "set aside" and "permanently enjoined." This order is subsequent to a 2006 California District Court ruling that set aside the 2005 State Petitions Rule and reinstated the 2001 Roadless Rule. See *California ex re. Lockyer v. US Department of Agriculture*, 459 F.Supp.2d 874 (N.D. Cal 2006). The United States Justice Department, on behalf of the Department of Agriculture, has filed motions with both the Wyoming and California courts seeking adjustments of those courts' conflicting judicial orders. Neither the Wyoming nor California District Court rulings bar the Department of Agriculture from promulgating other roadless area regulations. To address this inconsistency, the PEIS includes the following Department of Agriculture Roadless Area Stipulation, "If future legislation or regulation change the roadless area designation, the restriction would be revised along with any appropriate environmental review." An appropriate NEPA review would be required prior to any changes to the Roadless Area Stipulation.

Decisions regarding the management of areas with wilderness characteristics are made at the field office level as part of the local land use planning process and not in this PEIS. This allows wilderness characteristics to be evaluated at a finer scale than afforded at a programmatic level. The management and level of protection of the wilderness characteristics on non-WSA lands is discretionary and not bound by requirements of the Wilderness Act of 1964 or the WSA Interim Management Policy (IMP, H-8550-1; BLM 1995); thus, these areas have no official status that removes them from consideration for leasing. Nonetheless, the BLM must consider in its NEPA analyses possible impacts on wilderness characteristics, if present, and may manage the lands to protect and/or preserve some or all of those characteristics through the local land use planning process.

As noted in Chapter 2 of the Draft PEIS, before making any leasing decisions, the BLM will assess whether the existing NEPA documentation is adequate (i.e., through completion of a DNA), or whether there is new information or new circumstances that warrant further analysis. For example, additional NEPA analysis may be required in light of new information or from a potential change in management approach regarding resources identified for special management (e.g., travel management planning or areas under consideration by BLM for management for wilderness characteristics).

O-42-6

See above response to comment O-42-5 for response to lands with wilderness characteristics.

O-42-7

See above response to comment O-42-5 for response to lands with wilderness characteristics.

O-42-8

This has been noted and attention has been paid to sagebrush habitats and sagebrush species in the PEIS. The stipulations and BMPs provided in the PEIS focus on maintaining healthy sagebrush habitats and protecting species and allow individual Forest Districts and Field Offices to utilize the most effective measures to protect sagebrush resources.

O-42-9

As noted above, attention has been paid to sagebrush habitats and sagebrush species in the PEIS. The stipulations and BMPs provided in the PEIS focus on maintaining healthy sagebrush habitats and protecting species and allow individual Forest Districts and Field Offices to utilize the most effective measures to protect sagebrush resources.

The BLM and FS have added the following procedure prior to leasing in Chapter 2:

> The authorized officer of the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states manage and typically have regulatory authority for water quality, water rights, and wildlife.

O-42-10

The sensitive species-specific stipulation in Section 2-19 states:

> For agency-designated sensitive species (e.g., sage grouse), a lease stipulation (NSO, CSU, or TL) would be imposed for those portions of high value/key/crucial species habitat where other existing measures are inadequate to meet agency management objectives.

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> The authorized officer of the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states manage and typically have regulatory authority for water quality, water rights, and wildlife.

O-42-11

Lands designated as open to leasing are subject to existing laws, regulations, and formal orders. In complying with these laws, regulations, and orders, some of the open lands may not be available for leasing. Chapter 2 explains, under *Procedures Prior to Leasing*, that the BLM and FS would comply with the requirements of the Endangered Species Act, including determining if any listed or proposed threatened or endangered species, or critical habitat, is present on nominated lease parcels and may be affected by any decision to lease. Chapter 6 of the Final PEIS, in turn, explains that the agencies have determined that the decision to lease has no effect on listed species or critical habitat.

To provide further protection for threatened, endangered, and sensitive species, the BLM will impose an Endangered Species Act stipulation (see Section 2.2.2) on all geothermal leases.

O-42-12

Thank you for your comment. The BMPs and stipulations provided in the document include guidance for identifying and avoiding essential habitat as well as ungulate and other wildlife migratory corridors in making decisions on individual projects.

O-42-13

The US Fish and Wildlife Service would be consulted for individual leasing decisions.

O-42-14

Additional discussion has been added to the cumulative impact analysis, including discussion of other energy projects. As noted in Chapter 5, past, present, and reasonably foreseeable actions, including commercial uses of public and federal lands, are documented and analyzed.

O-42-15

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September 19, 2008

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c/o EMPSi
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Comments to Draft Geothermal Resources Leasing Programmatic EIS

Via E-Mail to geothermal_EIS@blm.gov

This letter is submitted on behalf of the American Petroleum Institute ("API"), in response to the joint Programmatic Environmental Impact Statement (PEIS) to analyze and expedite the leasing of BLM-and FS-administered lands with high potential for renewable geothermal resources in 11 western states and Alaska. API represents nearly 400 companies that are involved in various aspects of the geophysical, oil and natural gas exploration, production and service industries.

America needs a balanced, energy policy that promotes energy efficiency and conservation and greater supplies of all forms of energy, including geothermal energy resources and domestic oil and natural gas. C-43-1
Multiple use public lands in the American West offer both geothermal and hydrocarbon resources. It is vitally important to wise planning for America's energy future that opportunities for development of one energy resource do not come at the expense of the other. Full access to hydrocarbon resources under multiple use public lands is of particular concern to the oil and natural gas industry that API represents, because only 17 percent of non-park, non-wilderness federal lands administered by the federal government is open to energy development under standard lease terms.

In its landmark "Facing Hard Truths" energy study, published July 18, 2007, the National Petroleum Council (NPC) described the importance to America's economy of full access to all forms of energy. To mitigate the risks of continued dependence on the present mix of energy resources, NPC said "expansion of all economic energy sources will be required, including coal, nuclear, renewables, and unconventional oil and natural gas". To safeguard the nation's energy and economic future, a balance must not only be sought among the mix of energy resources to be utilized in the American economy; a balance must be achieved in policies, regulations and decision-making to address the infrastructure requirements for development and delivery of these resources.

Geothermal resources represent an emerging technology of increasing importance with respect to generation of electricity and in specialized applications such as heat for greenhouses and aquaculture. Some API member companies are directly investing in geothermal energy projects. As BLM has noted, half of the nation's geothermal energy production occurs on federal lands, much of this production energy API

occurring in California and Nevada. It is estimated that 90% of the potential geothermal resource may be found on public lands as well.

The primary concern of the oil and natural gas industry with respect to the prospect of leasing multiple use public lands for geothermal resources is that every effort be made to avoid the possibility of conflicts between developers of hydrocarbon and geothermal resources on those public lands where both types of resources may be found. This should be achievable, but it should be remembered that exploration and development for both hydrocarbon and geothermal resources below the surface can require use of portions of the surface as well as the subsurface. In the case of hydrocarbons, seismic surveys and/or geoscience interpretation may be necessary. If initial exploration drilling succeeds in locating oil or natural gas accumulations, and a decision is made to pursue development, engineering design, permitting and construction of the gathering, compression and other facilities and equipment will be required to handle the production of the resources identified through exploration drilling. Because geothermal resources are also fluid mineral resources, similar activities are generally required for their development. The draft PEIS suggests in Section 3.4 that development of the two types of resources on the same public lands tracts could be sequential, but it is important that planning and consideration of possible impacts to development contemplate the possibility that there could also be concurrent development of hydrocarbon and geothermal resources on the same tract or tracts. C-43-2

In the event BLM were to grant concurrent hydrocarbon and geothermal leases covering the same public lands tract or tracts, both lessees possess a right to reasonable use of the surface estate necessary to explore for and to produce the leased resources, in accord with applicable statutes and regulations and lease terms and conditions. In the majority of cases, the lessees' exercise of their leasehold rights to develop their leasehold interest, and the accompanying right to use of the surface should be achievable without conflict.

API recommends that rules developed by BLM following final approval of the PEIS specify that in the event of conflicts between exercise of the leasehold rights by the geothermal and hydrocarbon lessee that cannot otherwise be resolved through negotiated agreement, the lessee whose lease is senior in time should enjoy a preference. This is in accord with generally accepted principles of natural resource law. Clarification of this approach by BLM would benefit lessees from both industries, as it would strongly encourage lessees to undertake due diligence to learn the resource potential of the public lands in which they are interested. Through due diligence lessees learn what can be learned concerning the identities of other leasehold interest owners and – to the extent possible – about foreseeable exploration or development scenarios that could potentially affect exercise of their own leasehold rights and interests. C-43-3

It is in the public interest to manage multiple use public lands for maximum benefit, and to permit full opportunity for exploration and production of energy resources consistent with multiple use and sustainable development. BLM administration of a geothermal resources leasing program, and ongoing management of lands for the development of geothermal resources in a multiple use context should take cognizance of active and ongoing exploration and production of hydrocarbon resources on many of the same lands. It is in the national interest that development of both categories of resources proceed to the extent feasible in a manner that does not constrain or limit the development of either resource. Toward this end, BLM needs to develop rules and guidance documents along with lease terms and conditions that set this as a priority for lease administration in situations of concurrent hydrocarbon and geothermal leases, with recognition of the priority of the senior leasehold interest in those situations where no other resolution is possible.

Thank you for considering these comments.

Very truly yours,

Richard Ranger

Richard Ranger
Senior Policy Advisor

C-43-1

Thank you for your comment. The comment has been noted.

C-43-2

It is beyond the scope of the PEIS to prepare leasing rules and regulations.

C-43-3

It is beyond the scope of the PEIS to prepare leasing rules and regulations for addressing conflicts between geothermal and hydrocarbon lessees that cannot otherwise be resolved through negotiated agreement.

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RE: Programmatic Environmental Impact Statement Comments

The state of Idaho thanks you for the opportunity to comment on the Bureau of Land Management's "Draft Environmental Impact Statement (PEIS) for Geothermal Leasing". Idaho's comments are divided into general comments on the three alternatives and comments that are more specific to the PEIS.

<u>General Comments on the Alternatives</u>

Under the proposed action, the Bureau of Land Management (BLM) and the U.S. Forest Service (FS) have identified three Alternative proposals. Alternative B represents the federal agencies' preferred option and it includes approximately 192 million acres of land that would be open to geothermal leasing. Leases under this proposal would be subject to existing laws, regulations, formal orders, stipulations, and other terms and conditions of the standard lease form. This Alternative makes it clear to potential developers that National Parks, wild rivers, wilderness areas, and national recreation areas are closed to geothermal leasing. Many of these areas are currently considered statutorily closed. Identifying these areas as closed is perceived to assist developers by helping them avoid applications that would essentially be unrealistic to move forward.

Idaho's review of the Draft PEIS supports Alternative B as the most reasonable option toward improving the geothermal leasing process. Alternative B appears to represent the best alternative to facilitate decisions on future lease applications and nominations on the federal mineral estate in the western United States. By excluding acreage that is statutorily off limits, potential developers will be able to focus attention on parcels that have legitimate opportunities for projects. This ultimately improves the leasing process by reducing risk and time delays. A-44-1

In assessing the status quo option (Alternative A), it provides no guidance or potential process enhancements. Alternative A (business as usual) would still allow applications to move forward on a case-by-case basis, but if the desire is to facilitate a more rapid development of renewable resources, this option offers no enhanced benefits.

Regarding Alternative C (Leasing Lands Near Transmission Lines), this option respects the realization that electric generation via geothermal resources is dependent on access to transmission. However, this alternative ignores the possibility that the generation capacity of a potential project could support the cost of extending transmission lines to the site. Accordingly, an arbitrary proximity to existing transmission should not by itself preclude project development. Another factor to consider in rejecting Alternative C is the potential federal requirements could have on the financial viability of renewable low-carbon projects that today might be considered too distant from existing transmission capacity.

It is recognized that an awarded lease is not approval to begin geothermal exploration. Developers still must obtain appropriate approvals to initiate drilling activity and accordingly must adhere to NEPA/EIS considerations. When projects emerge, Idaho reserves its right to provide site-specific comments related to indirect impacts and cumulative effects analysis pertaining to fish and wildlife resources and associated recreation and that management practices and mitigation ensure these resources are sustainable. The Sate of Idaho also recommends that full consideration be given to those species and habitats identified as those of greatest conservation need in the Idaho Comprehensive Wildlife Conservation Strategy (CWCS) (http://fishandgame.idaho.gov/cms/tech/CDC/cwcs_table_of_contents.cfm). A-44-2

Specific Comments on the Draft PEIS

The State of Idaho offers the following comments related to specific sections of the Draft PEIS. These comments are not intended to encourage closure of additional parcels to geothermal development. Instead they are offered to encourage full disclosure of potential considerations associated with sites in an effort to provide potential developers with necessary information to assess risk. Idaho also encourages the BLM and FS to identify potential barriers to development for a location (road access, known habitat for endangered species, etc). Whenever possible, stipulations on parcels should be posted in advance to any lease process in an effort to provide developers with information necessary to making informed decisions about specific sites. A-44-3

Volume1: Programmatic Analysis

Each geothermal plant will require ½ mile to nine miles of access roads. There are many negative effects of roadways on wildlife and wildlife habitat and they are well documented. We are concerned and interested in how these new geothermal plants will mitigate for the direct and indirect effects of increased roadways on wildlife and their habitat, including related issues such as noxious weed invasion, fire occurrence and frequency, and other disturbances reducing habitat access and use. We specifically recommend the final PEIS stipulate how mitigation for these and other effects on fish and wildlife and fish and wildlife recreation will be assessed, identified, and implemented. If possible, the PEIS should state how mitigation actions will help insure no significant and preferably, no net loss of wildlife habitat in relation to geothermal development. A-44-4

Each plant will require 5 – 50 miles of electric transmission lines. Each mile of transmission line would disturb approximately one acre via its footprint but would likely have much broader effects through direct and indirect effects of transmission towers, clearing, human disturbance, noxious weed introduction, and the increased potential for fire. In many cases, the specific effects of electric transmission lines on wildlife such as sage-grouse are suspected but undocumented (e.g. increased predator perching and nesting opportunities, behavioral avoidance, etc.). It is recommended that the final PEIS stipulate how mitigation for these and other effects on fish and wildlife and fish and wildlife recreation will be assessed, identified, and implemented and help realize no significant loss of wildlife habitat. A-44-5

2.2.2 Lease Stipulations, Best Management Practices, and Procedures
Lease Exceptions, Waivers, and Modifications, page 2-14
The draft PEIS states "*During the review process, coordination with other state or Federal agencies should be undertaken, as appropriate, and documented.*" A-44-6
The following language change is recommended: "During the review process, coordination with other state or Federal agencies *will* be undertaken and documented."

No Surface Occupancy Lease Stipulations, page 2-16
It is unclear how the No Surface Occupancy (NSO) lease stipulation will be applied. The draft PEIS states that NSO stipulations are a "*major constraint as they do not allow for surface development.*" It goes on to state that "*These NSO stipulations apply only when standard lease terms included on the standard lease form, Best Management Practices (Appendix D), and other stipulations would not adequately achieve resource protection.*" As noted below, BMPs may not be a required element of the lease application. There is a perception that adequate resource protection may not be achieved through BMPs if they are not a required element of a lease application and/or are not a BLM condition of approval, i.e. voluntary. Addressing this issue in the final PEIS could provide the necessary clarity. A-44-7

Best Management Practices, page 2-20
The draft PEIS states "*Best Management Practices are state-of-the-art mitigation measures and may be incorporated into the permit application by the lessee or may be included in the approved use authorization by the BLM as conditions of approval.*" "Best management practices" can be viewed as the state-of-the art level by which projects will be implemented. In terms of fish and wildlife, such practices might include construction timing, weed control, access restrictions, revegetation, etc. Such practices are separate from mitigation, which are actions taken to balance unavoidable project impacts such as loss of habitat due to the project footprint or wildlife disturbance and exclusion due to project operations. It is recommended the above statement be changed as follows: "Best Management Practices *will* be incorporated into the permit application by the lessee or *will* be included in the approved use authorization by the BLM as conditions of approval." A-44-8

Procedures Prior to Leasing, pages 2-20 to 2-22
Under this section, there is no required consultation with state agencies prior to developing leases. While this may not be required under federal law and regulations, it would be a prudent measure to include given the wealth of knowledge state agencies have concerning fisheries and wildlife distribution, critical habitat designations, migration corridors, information regarding special status species, and energy resource development potential. A-44-9

Site Specific Comments
Of the sites identified (1-page Geothermal Power in Idaho Current Developments and Future Potential) in Region 6 IDFG, the Rexburg Caldera is primarily developed and intensively farmed; we would expect few negative effects of geothermal development there with the exception of farmland game species. The Willow Springs site would likely require more consideration for wildlife species should geothermal development occur. Both big game and ground-lekking birds are common around the Willows Springs area. There might be potential interruption of migratory patterns if above-ground piping were used. This area is also within IDFG's Mule Deer Initiative focus area and as such is one of extremely high value in terms of big game habitats in this area. It would be prudent to make potential developers aware of these considerations prior to nominating these parcels for lease. A-44-10

Areas of Critical Environmental Concern

There are a significant number of notable Areas of Critical Environmental Concern (ACEC) included as potential geothermal leases. For example, in southwest Idaho, such areas total ~330,000 acres as being open to geothermal leasing. In terms of wildlife, these include areas of: Owyhee bighorn sheep habitat (Owyhee and Bruneau field offices, 168,399 acres), long-billed curlew habitat (61,000 acres), Columbian sharp-tailed grouse habitat (4,200 acres), Boise Front (12,000 acres), and the Bruneau-Jarbidge River (bighorn sheep habitat and cultural resources, 85,224 acres). Several of these ACECs have special management requirements, including NSO and Timing Limitation (TL) that may or may not limit leasing opportunities. These areas, because of their special management considerations for wildlife, will pose more complexity and will probably be more restrictive to work with for geothermal development than other, less management restricted areas. A-44-11

Of the sites identified (1-page Geothermal Power in Idaho Current Developments and Future Potential) containing geothermal power potential with potential wildlife concerns include Vulcan Springs, White Lick, the Bennett Mountains, and the Raft River. The Vulcan Springs area provides important summer range for elk and mule deer. The route most likely to be used for electric transmission from White Lick would pass through important winter range for mule deer and elk. The Bennett Mountains are especially important as mule deer and elk winter and summer ranges; the Bennett Mountain winter range supports the third highest density of wintering mule deer in Idaho. The Raft River area provides important winter habitat for mule deer, seasonal habitat for sage-grouse, nesting habitat for ferruginous hawks and other raptors, and year-round pygmy rabbit habitat. Recognition of these considerations will provide potential developers with useful information as they consider leases on these parcels. A-44-12

While the Draft PEIS focuses on federal land leases, the possibility that state lands could be impacted due to proximity is worth considering. An example of an associated impact includes the potential need for new transmission lines to serve geothermal resources located on federal lands. These transmission lines could possibly require access to state lands. Accordingly, it is of some benefit to understand the concerns associated with access to state lands.

As background, the Idaho Department of Lands, at the direction of the State Board of Land Commissioners, manages Endowment Trust Lands within the State. All Endowment Assets of the State of Idaho must, per the Idaho Constitution [Article 9], be managed "in such a manner as will secure the maximum long term financial return" to the Trust Beneficiaries. The Assets will be managed to provide a perpetual stream of income to the beneficiaries by: A-44-13

- Maximizing long-term financial return at a prudent level of risk;
- Protecting future generations' purchasing power; and
- Providing a relatively stable and predictable payout.

In December 2007, the Land Board adopted the *State Trust Lands Asset Management Plan* addressing the overall management of Endowment Lands within Idaho. The IDL *Annual Report for 2007* . These documents can be viewed at the following internet links:
http://www.idl.idaho.gov/am/am.html and
http://www.idl.idaho.gov/News/annual_reports/ar_2007.pdf.

Keeping in mind the Idaho Department of Lands' mission, the following comments are submitted:

1. Any use of Endowment Lands will require application for, and approval of, term easements with fees based on current market rates. Term easements may include multiple uses in some locations. Final location of any easements should be placed, wherever possible, in locations that will result in minimal negative impact to the function and productivity of Endowment land.

2. The ability of Idaho Department of Lands to manage the Endowment Assets for the maximum benefit of the beneficiaries will be impacted by this project. Among these impacts are:
    a. Spread of noxious weeds. Area-specific management plans will be necessary to protect all abutting land owners.
    b. Potential loss of access to Endowment Lands.
    c. Increased trespass activity due to proximity of new roads to Endowment Land.

3. Geothermal leasing of federal lands should be used as a motivator for an expedited process for land exchange in intermingled ownerships and to remedy current split estates. Management costs for these types of ownership are high and not in the best interest of either the Federal Agencies or State Endowment Lands.

4. The Idaho Department of Lands favors opening as much federal ownership for geothermal leasing as possible. Due to intermingled ownership, limiting federal leasing has a negative impact on possible future revenues for our beneficiaries.

5. Siting and leasing of commercial production improvements on State Endowment Lands is highly desirable.

Thank you for the opportunity to provide comments on the Draft PEIS for Geothermal Leasing of Federal Lands. The State of Idaho looks forward to working closely with the BLM and FS. Please contact me at (208) 287-4903 if you have any questions about the issues identified in this letter.

Sincerely,

Paul Kjellander

Paul Kjellander, Administrator
Idaho Office of Energy Resources

A-44-1

The commentor's support for Alternative B is noted.

A-44-2

The comment is noted. Subsequent environmental analysis prior to development and utilization will fully comply with NEPA and provide the opportunity for comment and involvement of the State of Idaho, when appropriate.

A-44-3

The comment is noted. The procedures prior to leasing identified in Section 2.2.2 would be implemented prior to inclusion of a parcel in a lease sale. These procedures would include identification of cultural resources, habitat for listed species, and other barriers to development.

A-44-4

BMPs designed to mitigate the impacts of geothermal development on wildlife habitat are included in Appendix B.

A-44-5

The PEIS provides analysis for the potential effects on sage-grouse and other sagebrush species from foreseeable on-the-ground actions, including transmission line impacts, and provides BMPs and stipulations to protect these species and habitats. BLM Resource Management Plans would be amended to adopt the stipulations, BMPs, and procedures.

A-44-6

Language in the Final PEIS has been changed to "coordination with other state and Federal agencies would be undertaken, as appropriate, and documented."

A-44-7

Stipulations provided in this PEIS would serve as the minimal level of protection and would be adopted into local land use plans upon signing of the record of decision. If an existing land use plan offers more protection, then those measures would apply instead (see Section 2.2.2 *Lease Stipulations*). The NSO is the most restrictive stipulation; therefore, it is applied if there are no other remedies. BMPs are not applied to leases but can be placed on permit applications as a condition of approval for any subsequent activities on the lease area. This process is handled during the environmental review process for the specific application. Example BMPs are provided in the PEIS to allow the public to see what tools are available and help the public provide input during the permitting process. The list of BMPs is not inclusive, in that local BLM field offices may apply other BMPs specific to the local site conditions. The BLM has added some text to the NSO discussion to help clarify the process.

A-44-8

The text has been revised to make the clarifying point of the comment.

A-44-9

BLM Field Offices collaborate closely with appropriate state agencies, especially in the case of geothermal energy where the states manage and have regulatory authority for water quality, water rights, and wildlife. The following text has been added to the Final PEIS under *Procedures Prior to Leasing*: "Collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states manage and have regulatory authority for water quality, water rights, and wildlife."

A-44-10

Thank you for your comment. It is beyond the scope of the PEIS to provide location-specific data for all potential geothermal development areas. However, this comment will be recorded in the public record and will be available to anyone reviewing the document.

A-44-11

The ACEC list included in Appendix C contains stipulations for each ACEC, as determined under oil and gas regulations.

A-44-12

Thank you for your comment. It is beyond the scope of the PEIS to provide location-specific data for all potential geothermal development areas. However, this comment will be recorded in the public record and will be available to anyone reviewing the document.

A-44-13

The PEIS document is concerned with geothermal leasing on BLM- and NFS-administered lands. Coordination with any affected agencies, including state land boards, would be undertaken as appropriate for specific projects.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
ENFORCEMENT AND
COMPLIANCE ASSURANCE

SEP 17 2008

Mr. Tracy Parker
Mr. Jack G. Peterson
Draft Geothermal Leasing PEIS
c/o EMPSi
182 Howard Street, Suite 110
San Francisco, CA 94105-1611

Dear Mr. Peterson and Mr. Parker:

The U.S. Environmental Protection Agency (EPA) has reviewed the Draft Programmatic Environmental Impact Statement (EIS) for Geothermal Leasing in the Western United States (CEQ #20080240) pursuant to the National Environmental Policy Act, and our authority under Section 309 of the Clean Air Act.

In accordance with the Energy Policy Act of 2005, the Bureau of Land Management (BLM) and the Forest Service (FS) are proposing to make decisions on geothermal lease applications submitted prior to January 1, 2005, in the current planning area of 192 million acres and to facilitate decisions on other existing and future lease applications and nominations covering a total area of 248 million acres. The Draft Programmatic EIS presents both broad impacts associated with the proposed action and alternatives, as well as more lease-specific analysis on 19 pending applications in seven geographical clusters of the planning area encompassing 36,937 acres. The alternatives evaluated included a no action alternative, potential leasing of 192 million acres (proposed alternative), and leasing within a 20-mile corridor from existing transmission lines.

The proposed project area covers 12 states with most of the potential leasing occurring in Nevada, western Utah, Idaho, California and southeast Oregon. The draft EIS states that "groundwater is the primary water resource that is potentially affected by geothermal exploration and development" (pg. 3.72). This is due to potential mixing of geothermal fluids from re-injection with surface or groundwater. With 23 sole-source aquifers located in the planning area, EPA has environmental concerns that the proposed action could potentially result in adverse impacts to groundwater quality, particularly sole-source aquifers. We recommend that the final EIS identify the types of mitigation measures that would be considered to protect these resources and how groundwater will A-45-1 be monitored to detect infiltration of industrial fluids used in geothermal energy production.

The draft EIS states that there are areas designated as non-attainment or maintenance areas for Particulate Matter (PM_{10}) in the planning area. While we understand the general conformity rule will be followed in non-attainment areas, EPA has environmental concerns that without the necessary monitoring and mitigation measures air quality may be adversely impacted by the construction, and other emission sources. The final EIS should address what measures will be implemented to reduce impacts to air quality. A-45-2

The draft EIS states that, "BLM regulations mandate that noise at one-half mile from geothermal operations, or at the lease boundary, if closer, shall not exceed 65 units of decibels A-weighted". However, it appears that all phases of geothermal exploration and development except reclamation and abandonment exceed this threshold. (pg. 4-154) Accordingly, EPA recommends that the final EIS discuss how the project will meet BLM noise regulations including a discussion of appropriate mitigation measures. A-45-3

Consequently, in accordance with EPA's Policies and Procedures, we have rated the draft EIS as Environmental Concerns – Insufficient Information (EC-2). While EPA supports the development of geothermal energy as a renewable energy source, the proposed actions have the potential to have adverse impacts to air quality and groundwater. A-45-4

EPA appreciates the opportunity to review this Draft Programmatic EIS. I am available to discuss our comments if you have questions. I can be reached at (202) 564-5400 or you can contact Jessica Trice of my staff at (202) 564-6646.

Sincerely,

Susan E. Bromm

Susan E. Bromm
Director
Office of Federal Activities

A-45-1

Prior to leasing, the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states typically manage and have regulatory authority for water quality, water rights, and wildlife. Site-specific impacts on water resources, including groundwater would be addressed as part of the environmental analysis for the permitting process. In addition, cement and casing of the well bore is designed to prevent mixing of reservoir zones. Although older casings can leak (more often in reinjection wells than production wells), they are inspected and tested to prevent this occurrence at regular intervals, and can be repaired. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis, including public involvement, as appropriate. The BLM and FS would work with interested and affected parties to identify and resolve user or resource conflicts. Appropriate site-specific mitigation would be developed, as necessary.

A-45-2

Appendix D lists specific mitigation measures and monitoring requirements that will be incorporated into issued leases if determined to be appropriate after coordination with state agencies.

Mitigation measures, including lease stipulations, conditions of approval, and the general operation of geothermal developments, would be monitored by the lessee or the appropriate Federal agency to ensure their continued effectiveness through all phases of development. Using adaptive management strategies, where mitigation measures are determined to be ineffective at meeting the desired resource conditions, the BLM and FS would take steps to determine the cause and would require the operator to take corrective action. This information would also be used to inform future geothermal leasing and development.

A-45-3

The normal operations of geothermal plants are typically comparable to common everyday sound levels and would remain under the 65 dB A-weighted threshold (dBA). In extreme situations (e.g., Enhanced Geothermal Systems), noise levels could exceed 65 dBA; however, prior to any construction-related activities, site-specific analysis would be conducted to ensure all noise regulations would be met prior to approval. Additional text has been added to Chapter 4 to clarify this difference.

A-45-4

The BLM appreciates the EPA’s review and active participation in the preparation of the PEIS.

geothermal_eis

From: Mary_Christensen@blm.gov [Mary_Christensen@blm.gov] **Sent:** Wed 9/17/2008 10:44 PM
To: geothermal_eis
Cc:
Subject: Mail forwarded from geothermal_eis@blm.gov
Attachments:

This message has been automatically forwarded from geothermal_eis@blm.gov.

raymondBulleiwiLa To
hisdinikkaaji geothermal_eis@blm.gov
allovertherez cc
<rimrockwalker@ya rimrockwalker@yahoo.com
hoo.com> bcc

09/17/2008 11:41 Subject
PM COMMENTS ON DRAFT PEIS

Please respond to
rimrockwalker@yah
oo.com

|--|
| Hello |
| My Name is Raymond Alvarez, I am a Member / Councilman for the |
| Hewisedawi Band Of Pit River Indians. The following are my comments on |
| the Draft PEIS. I believe that the geothermal resources on public lands|
| need to be utilized as long as intensive environmental impact studies |
| are conducted insuring the safety and preservation of all outdoor |
| life. Also I believe that better consultation needs to be conducted |
| with local Federally Recognized Native American Tribes/Bands that still|
| utilize these lands for gathering/spiritual purposes. Should a project |
| be approved, and the impact studies suggest a geothermal plant is |
| viable on certain public lands, and the local Tribes/Bands agree and |
| support the project, I believe they should be considered when any |
| royalties are given out. If a project gets approved, tribal |
| Archaeologists/Monitors from the Tribes/Bands of that area need to be |
| fully utilized on any ground disturbance activities. In so, giving the |
| Native Americans full responsibility for the safe handling of any |
| artifacts or remains of previous Native people. Thank you for your time|
| and consideration, |
| Raymond Lee Alvarez, Bulleiwi |
| Hewisedawi Band- Councilman |

A-46-1

A-46-1

As stated in the PEIS Section 2.2.2 *Procedures Prior to Leasing*, the authorized officer for the BLM or FS will consult with Native American Tribal governments, Alaska Natives, and State Historic Preservation Officers. Through consultation, the agencies would identify tribal interests and traditional cultural resources or properties that may be affected by the Federal leases and by potential geothermal energy development and the presence of archaeological sites and historic properties per Section 106 of the National Historic Preservation Act.

Royalties are administered consistent with 30 CFR Parts 202, 206, 210, 217, and 218 (Geothermal royalty payment, direct use fees, and royalty valuation; final rule dated May 2, 2007).

TROUT UNLIMITED

Sent via Email: geothermal_EIS@blm.gov
and Certified Mail, Return Receipt Requested

September 17, 2008

BLM Geothermal Programmatic EIS
c/o Environmental Management and Planning Solutions, Inc.
182 Howard Street
Suite 110
San Francisco, CA 94105

RE: Comments on Draft Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States

Dear EMPSi staff:

Please accept the following comments from Trout Unlimited on the Draft Programmatic Environmental Impact Statement (PEIS) for Geothermal Leasing in the Western United States. Trout Unlimited is offering these comments after reviewing the PEIS document and observing the lack of significant discussion and consideration of geothermal impacts to waters, groundwater contamination, fish and wildlife habitat in the western United States.

O-47-1

Trout Unlimited (TU) will discuss the concern we have regarding the lack of solid analysis with respect to actual environmental consequences of geothermal development and the amending of 122 land use plans covering more than 248 million acres. Additionally, TU notes that this PEIS document requests comments on the 19 pending lease applications (Volume II, PEIS) that have been submitted to the BLM, tiering the analysis of these applications to the future geothermal leasing stipulations which are only broadly discussed in a general way in the first volume of the PEIS. These 19 lease applications, if approved, will have significant impacts to the national forests in which they are located. The lack of any thorough environmental analysis (outside of the few pages devoted to each area in Volume II) is not consistent with performing required NEPA analysis prior to any leasing that results in a meaningful evaluation and analysis. Further, throughout the PEIS, the BLM claims that they are unable to provide anything other than a broad superficial perspective of geothermal impacts to the environment based on the size of the areas impacted. The BLM notes that the Preferred Alternative B will impact 82 percent of public BLM lands and 70 percent of national forest lands (PEIS, p. 4-7). The BLM is doing the public a great injustice by not providing a more careful and comprehensive meaningful document containing information that would allow the public a more equitable evaluation of the PEIS proposal from which to comment on.

Because the content of the PEIS contains too little information to accurately assess the environmental consequences of commercial geothermal development, TU feels that the BLM should select Alternative A until the agency can more accurately define and implement geothermal impacts and lease stipulations. Alternative A (No Action Alternative) would not amend the 122 land use plans but rather allow the current process of site-specific analysis continue within the individual respective agency field offices using the existing land use plans, many of which are currently undergoing revisions. Though this would most likely require additional NEPA documentation and possible amendments to plans, this alternative would continue to provide analysis while the BLM further evaluates the PEIS for geothermal leasing. 0-47-2

Background

TU is one of the largest private non-profit conservation organizations dedicated to conserving, protecting and restoring North America's trout and salmon fisheries and their watersheds. Established in 1959, TU has more than 155,000 members nationwide supporting the mission for the protection of coldwater fisheries. TU recognizes that the value of public lands is unparallel in providing habitat to coldwater fisheries, drinking water and wildlife habitat. TU's expanding conservation program includes a public lands initiative that recognizes the importance of protecting public lands for the survival and restoration of wildlife and fisheries. TU's public lands initiative is not limited to anglers; TU recognizes that many people who fish also utilize public lands for hunting and wildlife viewing opportunities. TU believes that actions taken on public lands are ultimately reflected in the quality of fish and wildlife habitat and populations.

Of the 12 states where the PEIS has identified areas of geothermal potential, all 12 states have a TU public lands program that is responsible for the preservation, protection and enhancement of public lands. Volunteers and staff in these 12 states provide valuable resources and on-the-ground project development that assist in the protection and enhancement of fish and wildlife habitat. TU has participated in numerous initiatives, campaigns, and actions that offer collaboration, partnerships and recommendations toward the implementation of responsible energy development. TU supports ongoing efforts toward energy sustainability and renewable development, and recognizes the valuable role energy development plays in these 12 western states. However, TU has strong concerns that the current proposal for these lease activities and the proposed leasing program discussed in the PEIS will have lasting consequences and impacts from geothermal development on TU's members and non-members who hunt, fish, recreate, and do business in and around these areas.

The BLM Should Not Make a Decision on the Processing of Active Pending Geothermal Leases until the PEIS for Geothermal Leasing is Completed.

1. **Simultaneous Evaluation of Two Separate Documents in the PEIS Should be Halted.**

Included in the BLM's proposed actions of the PEIS is a separate action that requests the site-specific analysis on current leasing decisions on 19 pending lease 0-47-3 applications in 7 geographical clusters on public lands. These 19 pending leases are what are left of the 198 lease applications that were pending since January 1, 2005 (the BLM was required to reduce the backlog, as directed to do under Section 225 of the EPAct of 2005). According to the BLM, these pending geothermal leases have been backlogged for lack of stipulations for geothermal leasing and development. The BLM is asking the public to comment on both the proposed Draft PEIS on Geothermal Leasing (Volume I) and the PEIS Analysis for Pending Lease Applications (Volume II). This request appears to be inherently conflicting, since the BLM is simultaneously approving leases from the 2005 backlog while also seeking approval for a broad leasing approach under the PEIS, and both documents are in draft stages.

It would seem a more prudent move and reasonable request that the PEIS on Geothermal Leasing be completed prior to the approval of the PEIS Analysis for Pending Lease Applications. It is difficult for the public to evaluate site-specific analysis on actions that have little or no stipulations and are awaiting a broader scope of work analysis and direction in a separate PEIS.

2. The BLM Should Not Commit Lands to Being Leased Prior to the Finalization of the PEIS on Geothermal Leasing.

Because the BLM has not developed or finalized regulations governing geothermal leasing, the assertions that designating lands as available for leasing will not have impacts, and that meaningful NEPA analysis will take place prior to leasing, are not supported. Without any regulations currently in place, and knowing that the regulations will undoubtedly undergo great revision during the public process associated with their promulgation, the BLM simply cannot assure the public that the future NEPA processes will adequately provide a forum for informed decision making with meaningful public participation. It also confounds and misdirects the public's ability to adequately and conscientiously provide thoughtful and meaningful input to 19 pending lease applications. Those 19 pending lease applications should each have a separate and more comprehensive environmental impact analysis prior to any approval under this PEIS. The nature of the impacts to the environment from the type of development required for geothermal production demands this. The lack of detailed groundwater evaluations, hydrogeologic analysis (particularly since so many areas are in earthquake zones), air quality impacts, and climate change analysis completed on any of the 19 applications speaks to this request. 0-47-4

Moreover, under traditional oil and gas leasing principals, once a RMP identifies lands as available for leasing, the lands are committed for leasing with no further NEPA review or public input, with the only exception being a protest to the leases. Without having publicly vetted and finalized regulations in place that will govern the geothermal leasing process, the BLM's assurances that the public will have further opportunity to comment prior to leasing cannot be wholly accepted. Proponents of specific leasing applications could argue, using the conventional fluid minerals program as precedent, that once the RMPs have been amended to allow commercial geothermal leasing, those lands are committed to leasing, subject only to lease stipulations – but not subject to a "no leasing" alternative. 0-47-5

Environmental Consequences of Geothermal Leasing

1. Poor Assessment of Consequences.

Within the content of the PEIS, statements were repeatedly made that it was not possible to identify specific impacts from the decision to approve a geothermal lease or to designate federal lands as open or closed to geothermal leasing. Rather, the PEIS has chosen the route of presenting "common impacts" from geothermal development by analyzing the Reasonable Foreseeable Development Scenarios (RFDS) and trying to assess the potential impacts based on a list of four phases of geothermal development. While TU appreciates the fact that the BLM is trying to consider more "environmentally sensitive" opportunities to develop resources and meet energy demands, we feel that this PEIS is very weak in its analysis. In fact, since the four phases of geothermal development are similar if not exactly like those of oil and gas development (exploration, drilling operations, utilization, and reclamation and abandonment) we feel the BLM has ample examples of the impacts associated with oil and gas development to fish and wildlife habitats, and to air and water quality, and those types of analysis and consequences should be included in this PEIS. By encompassing this generality for such a large expanse of the public's land that has the potential to be impacted (more than 248 million acres covering 12 states) TU feels that the BLM owes the public a more accurate and thorough analysis. This is especially necessary since this analysis of impacts already exists and because the BLM is simultaneously requesting the review of those 19 pending lease applications using the Draft PEIS as a reference source. 0-47-6

2. Impacts Should be More Thoroughly Analyzed Given the Available Information

The BLM cannot avoid its obligation to analyze the broad environmental consequences of commercial geothermal development merely by stating the consequences are unclear and will be analyzed later in other NEPA documents. Taken to the logical extreme, if a federal agency were able to defer analysis of environmental consequences in an EIS based on a promise to perform the analysis in connection with later site-specific or smaller projects, no environmental impacts would ever need to be addressed in an EIS. This would render the EIS process meaningless. 0-47-7

In the PEIS, the BLM has deferred analysis of environmental impacts to future lease-specific NEPA processes (with the exception of the 19 pending lease applications). While TU does support further NEPA analysis prior to the government's issuance of commercial leases, doing so in the absence a meaningful, existing basin-wide impacts analysis will result in a tyranny of small decisions that will not take into account the large, landscape-level consequences of a commercial geothermal program. The vast water, wildlife, and fisheries resources in the 12 western states would be made subject to a death of a thousand cuts.

The inability of the BLM to perform a meaningful impacts analysis at this time, though, only underscores the flawed nature of this PEIS process. The BLM should perform its analysis of landscape-level environmental consequences now, because to defer such analysis would allow for broad impacts to escape review. Despite the Congress' best intention to facilitate geothermal development by directing the BLM to perform this analysis, the BLM should lay back those 19 pending lease applications until the first PEIS analysis is complete. The only responsible land-management decision on behalf of the public would be to select Alternative A and defer the decision on whether to make available certain lands for commercial leasing until the BLM's commercial leasing regulations are finalized. This selection of Alternative A would also free up the pending 19 leases to a case-by-case decision analysis, of which the previous 89 pending leases were apparently successfully analyzed.

Throughout the PEIS, the BLM has indicated that impacts from geothermal development are difficult to predict. Yet, by its own admission the BLM has now approved 89 leases for development that apparently went through some level of NEPA evaluation and impact analysis. The remaining 19 geothermal leases that are under consideration in the second scope of this PEIS have been identified into 7 geographic clusters and identified for further supplemental environmental analysis. These separate geothermal proposals have evaluations of environmental consequences (Volume 2, PEIS) that are very limited in their scope and analysis. They should not be approved based on the lack of sufficient and meaningful NEPA review. O-47-8

The RFD scenario estimates that 110 power plants could be constructed by 2015 and another 132 power plants by 2025 (PEIS, p.4-5). Further, impacts associated with the utilization of surface area for geothermal plant construction involves significant and most likely permanent impacts of land use (PEIS, 4.2.3, p. 4-6). The generalization applied to the analysis of these impacts in this PEIS is unacceptable given the amount of public land that is at stake for geothermal development. As the PEIS states, the location and installation of one geothermal plant involves land disturbance ranging from 53 acres to 367 acres or more. Thus far, the projects which have been approved by the BLM for geothermal development all occur on U.S. Forest Service (USFS) lands, according to the PEIS. Of the 58.5 million acres of inventoried roadless lands within the USFS, more than 52.9 million of those acres are located within the geothermal project area. The PEIS states that roadless areas are the nation's most highly valued expanses of open space (PEIS, p. 3-12). Headwaters for sensitive native and wild trout species begin most often on USFS lands and west-wide more than 1,000 species of wildlife call the forest their home. The BLM is negligent if they do not expand their efforts to include a more thorough analysis of the impacts to fish, wildlife, air, water, recreation, soils, climate changes, and economic parameters given the incredible amount of acreage predicted to be impacted. O-47-9

3. Four Phases of Development Have Significant Impacts

The first two phases of geothermal development -- exploration and drilling – are consistent with those impacts associated with oil and gas development. These types of impacts have long-term and substantial impacts to soils, waters, air quality, and fish and wildlife habitat and populations. Geothermal utilization (the third phase of development) increases the impacts to the surface and subsurface resources on BLM or USFS lands. The fourth phase, reclamation and abandonment, might have little long-term impact but would most likely not occur for several generations, depending on the productive capability of the geothermal resource itself. O-47-10

Exploration for geothermal activity involves the use of off-road vehicles, helicopters, truck traffic, vibroseis equipment, drilling temperature gradient wells, and heavy equipment to transport those wells. Access roads, including new roads, will most likely be developed. Drilling operations would require production wells, injection wells, fluid sump pits and new access roads to accommodate larger equipment. The PEIS clearly states that this phase of development would impact land use activity, including displacement of activity such as wildlife use. The description of drilling operations also cites the fact that a drill site operation includes a well pad site that ranges between 5 and 50 acres per plant. That is in addition to the plant acreage disturbance estimated at anywhere from 53 to 367 acres. Adding on road miles, pipeline rights-of-ways, staging areas and housing areas, and a geothermal plant site might easily occupy more than a section of forest land. For this kind of permanent imprint onto wildlife habitat, the BLM should prepare more in-depth analysis.

<u>The PEIS is Too Broad and Should Not Be Used to Amend Land Use Plans</u>

The PEIS is extremely broad and effectively useless in its efforts to provide any decent site-specific review or analysis to the 12 states that will be impacted or the 122 land use plans that would have to be amended. TU fears approval of such a broad PEIS would result in amending 122 land use plans without recognizing the significance of special protection or designation areas, sensitive species, or significant cumulative and landscape impacts identified within these 122 land use plans. The PEIS does not consider in any detail the potential consequences of amending 122 land plans, especially in areas that have these special concerns or special management designations. O-47-11

By allowing the amendments of these land use plans to absorb the geothermal PEIS, the public is left out of the process. Leases would be approved without the necessity of further site-by-site analysis and would be against NEPA regulations, despite the BLM's claim that site-by-site analysis would occur within each BLM or USFS region. The BLM should not rely on the PEIS to justify the amendment of 122 land use plans.

<u>Alternative C Should Be More Thoroughly Analyzed Due to its Smaller Footprint and Updated Technologies and Infrastructure Development</u>

Under Alternative C less land (53% less than the Preferred Alternative B) would be open for indirect use of geothermal development (92.6 million acres) and would therefore reduce the impacts to fish, wildlife and those who use our nation's public lands in the West. The flaw that has been identified in the PEIS by the BLM for not choosing Alternative C is that the existing transmission line access to many states does not exist. However, since the publication of the PEIS, many states originally identified as limited in geothermal development potential now are pursuing various options for alternative energy development, including wind and solar, that require the same transmission infrastructure. And in many states, including the most limited states such as Wyoming and Nevada, that structure is being actively pursued and initiated. Therefore, Alternative C needs to be considered in a more updated and thorough manner. TU would consider supporting Alternative C given this more thorough analysis. O-47-12

1. Not Enough Evaluation Conducted on Impacts from Alternative C

The PEIS's discussion on impacts from geothermal development under Alternative C has been primarily dismissed and referred back to Alternative B as similar in nature. Yet, the PEIS fails consistently to identify the fact that under Alternative C, 53% less land would be developed than under Alternative B and therefore, less impacts to fish, wildlife, air, water quality, recreation, etc. would be inflicted. This is a significant number and should be given due consideration. This is especially important in light of the associated and significant impacts oil and gas development is currently having upon the nation's public lands and associated fish and wildlife habitat.

The PEIS broadly discusses the many impacts associated with geothermal development and likens these impacts to those that are similar to oil and gas development. This means an increase in roads, traffic, noise, loss of habitat, increased sedimentation and erosion, increased air emissions and decreasing air quality, loss of wildlife populations, habitat fragmentation, and increased water quality issues, pollution, and degradation. All of these impacts are currently being experienced on public and private lands in the west where oil and gas development is occurring. The PEIS should include a more expansive discussion on the ramifications of additional energy development on environmental resources. O-47-13

Reasonable Foreseeable Development Scenarios Are Not Realistic or Accurate

As discussed in the PEIS, the RFD scenario serves as a basis for analyzing environmental impacts resulting from future leasing and development of federal geothermal resources within the western U.S. over the next 20 years (PEIS p. 2-33). And while the BLM has approved 89 geothermal leasing projects since 2005, the PEIS states that few quantitative evaluations have been conducted on the typical impacts associated with geothermal development. This appears to be irresponsible on the part of the BLM and their management responsibilities to the public land resource. This is especially egregious in light of the fact that in other parts of the PEIS, the BLM states that geothermal development is similar to those actions used to develop oil and gas resources. More than 245 million acres are potentially being committed to geothermal leasing with very little analysis completed to the landscape scale and future impacts of this type of development on our nation's public lands. TU recommends that more analysis be committed to the RFD scenario discussion. O-47-14

In the discussion concerning impacts, the RFD scenario discusses those states expected to be leased for geothermal development. It is noted that Wyoming (with vast amounts of geothermal potential identified in the PEIS, Map 1-A, p. 1-16) is not included in any of the RFD analysis. When TU inquired as to the process for identifying individual states' assessment, the BLM replied that since there had been no previous inquiries in the last few years concerning geothermal development, the RFD scenario for this state (or any state with no inquiries) therefore, would be none. This level of assessment and poorly educated assumption appears to be undervalued in light of the recent push (since 2005) for alternative and renewable energy resource development. While the reason given for some state's low proclivity for development has been that the infrastructure for transmission lines is lacking, the BLM should not assume that because the transmission access has lacked progress in the past, it will therefore not be available in the future. Currently, Wyoming and many western states are strongly pursuing an increase in transmission line infrastructure and development. This action by the state changes the outlook for many types of renewable energy development, including geothermal, and should be fully evaluated in the PEIS. O-47-15

Significant Analysis is Lacking in Water Resources and Water Quality Discussions

The PEIS dedicates a mere 7 pages in discussing the consequences of geothermal development to water resources occurring in more than 248 million affected acres. It is worthwhile to note that within those 7 pages of discussion, the BLM recognized that geothermal activities would have potentially significant impacts from the associated phases of geothermal development. However, the broad cloak of handling these impacts is less than acceptable. In light of the on-going western-wide drought and climate changes affecting the West's water supplies, this lack of analysis is objectionable. TU strongly urges the BLM to readdress the discussion and more thoroughly analyze and quantify the impacts each state will have based on individual state's and region wide water issues. The data is available and the BLM's deferral of impact analysis to future individual lease applications only results in ignoring the significant water-related impacts, both locally and from regional basin-wide perspectives that will result without this analysis. NEPA regulations require that a more comprehensive analysis be addressed in a NEPA document. O-47-16

Water quality impacts that should be thoroughly addressed in the PEIS include the following: O-47-17

- <u>Commingling potential and occurrences during geothermal drilling operations.</u> As briefly discussed, drilling operations can result in contamination between geothermal drilling fluids and aquifers of differing water quality. Given the nature of the landscape habitat in which most geothermal operations will be located, degrees of impacts need to be evaluated and consequences more thoroughly discussed. Many of the geothermal locations exist in areas with shallow groundwater quality and the impacts of any contamination occurrences in these areas need further review.
- <u>The impacts from a region wide and watershed basin wide perspective need analysis.</u> Based on the nature of drilling and waste accumulation in geothermal operations, a more thorough discussion should be required due to the location of geothermal plants. Thus far, all of the already-leased geothermal operations are in US forest lands, including roadless areas. The potential for a large-scale pollution incident remains high without thoughtful discussion on mitigation and stipulations designed to avoid such impacts. O-47-18
- <u>Impacts to rivers, water quality in rivers and downstream reaches.</u> No analysis was presented on impacts to rivers other than a broad statement about Wild and Scenic Rivers being closed to geothermal development. Many rivers in our national forests contain sensitive fish species, provide vital food and water sources for all wildlife, and harbor threatened and endangered species. A more thorough analysis is needed that discusses impacts to river bodies, including downstream reaches should a contamination event occur. O-47-19
- <u>Impacts to fish and wildlife that are threatened or endangered.</u> Many landscapes of terrestrial and aquatic habitat in these 12 western states have various endangered species or sensitive species recovery implementation plans that serve to direct the protection of threatened species. Impacts to water bodies would affect all wildlife and fish species and the PEIS needs to discuss this in a more detailed manner due once again, to the location of the majority of geothermal operations in premiere fish and wildlife habitat. O-47-20
- <u>Setbacks from rivers, streams and riparian areas need evaluation.</u> The description of a geothermal plant provided insight to the size of such an operation. Due to the nature of potential impacts from drilling and utilization of O-47-21

geothermal resources, TU feels that stronger stipulations should be designated than increase controlled surface use and no surface use near riparian or wetland vegetation and streams and rivers. A minimum of one-quarter mile to one-half mile no surface occupancy or setbacks for a plant that will permanently (in our lifetime) be located should be implemented. There are numerous examples within the BLM and the USFS (and some state regulations) that have implemented such setback measures whether for seismic operations or full field development of oil and gas wells (Wyoming and Montana are two most recent examples). This offers protection to water quality and its numerous resource values and functions.

- <u>The increase in air pollution and emissions from geothermal plant activity.</u> Many areas of the western U.S. are experiencing a significant increase in air quality emissions resulting in higher and never-before-seen air pollution. Geothermal production does produce emissions from drilling or associated plant infrastructure. This is of particular concern with respect to fisheries and water quality, especially in the locations where geothermal plants are expected to occur, including backcountry roadless areas containing coldwater fisheries. Many of these backcountry streams and rivers contain threatened or potentially threatened and sensitive fish species. The majority of these wild and native trout species reside their entire lives in these isolated and small patches of headwater tributaries. Any changes in water quality, temperature, or quantity would affect these sensitive and vulnerable fish species and subject them to potential population decreases. Deposition from polluted air particles would negatively impact these species. Research has shown that many cutthroat trout species are particularly sensitive to the slightest change in the aquatic environment. 0-47-22

<u>Impacts to Fish and Wildlife are Not Adequately Discussed or Analyzed</u>

The PEIS provides a broad overview of the potential for wildlife and fish impacts from the activities associated with geothermal development but fails to take into account ongoing impacts that are occurring in various states to wildlife and fish from current energy development. The excuse that the BLM is unable to predict future development scenario impacts is unacceptable. Western states such as Colorado, Wyoming, Utah, California, and Montana are conducting research that document negative impacts to big game, sage grouse, fish, water and air quality from increased oil and gas development. This available data might alter the statements the PEIS offers, including the RFD scenario which states "The effects of implementing the RFD scenario would have very little effect on most species populations…and affect relatively small areas of habitat and would typically affect individual species instead of large populations." (PEIS, p. 4-74). In western Wyoming in the Pinedale Anticline gas field, a 46% reduction in a mule deer population has been attributed directly to oil and gas development (Hall Sawyer, West Inc., 2006. *Sublette Mule Deer Study: 2006 Annual Report*). Clearly this example illustrates the effects on a population of animals. Similar studies exist on impacts to antelope (Berger, et al, 2006; 2007) and sage grouse. 0-47-23

The PEIS contains two pages of an overview discussion on fish and aquatic biota and neglects to discuss the value of the importance of high mountain streams to many sensitive and threatened fish species. Significant impacts to fisheries have not been discussed or quantified and the PEIS needs to provide a more thorough analysis. 0-47-24

Further, the discussion of actions and potential impacts on fish and wildlife includes an additional two pages that are vague in discussion and ignore any discussion of impacts other than the fact that certain closed lands not available to geothermal leasing would protect wildlife and fisheries (PEIS, p. 4-93). This is a poor excuse for what should be a thorough review of potential conflicts, issues, landscape scale impacts, and consequences of loss of wildlife populations. TU adamantly requests that the PEIS reassess their evaluation of this section of analysis. 0-47-25

It is because of the lack of quantifiable data and a poorly demonstrated ability to discuss the impacts to wildlife and fisheries that TU asks the BLM to select Alternative A until more meaningful analysis regarding the actual environmental consequences of geothermal development to wildlife and fisheries be developed.

<u>The PEIS Does Not Adequately Consider Impacts Associated with Climate Change.</u>

The PEIS basically ignores climate change discussion and classifies it under the air quality discussion (p. 4-48). While the discussion on air quality contains some informed analysis, it refers to a 1977 permitting program that is not up to current standards (New Source Review permitting program) of emission controls and limits. And while Table 4-2 (PEIS, p.4-54) compares the carbon dioxide emission estimates from the projected 2015 and 2025 geothermal power plant electricity generation that is discussed in the RFD scenario, these plants are still emitting emissions that will be added to the already polluted air in Class I and II airsheds that are being impacted by oil and gas development. This cumulative scenario needs to be addressed more thoroughly. 0-47-26

The lack of air quality analysis to water resources and aquatic life, as TU pointed out in the discussion under water resources, is unacceptable, especially in light of those impacts likely to result from an increasingly warming climate. The BLM has been given a directive from five federal agencies (U.S. Departments of Agriculture, Interior, Defense, Commerce, and EPA) that order agencies to work to adapt water program management to reflect changing climatic conditions (Memo dated August 22, 2008; "Subject: Federal Agency Cooperation on Adaptation of Water-Related Programs to the Impacts of Climate Change"). Geothermal operations conduct their development operations and activities using large amounts of water resources and in areas located where direct impacts from warming climates affect the surrounding environment, including snow pack, stream and groundwater aquifers, recharge areas, and high elevation lakes. TU respectfully suggests that the BLM comply with this directive and address the climate change issue and its impacts in a more qualitative and quantitative manner. And until the BLM can sufficiently analyze the impacts of geothermal development and its impacts in a reasonably foreseeable climate change consequence, resulting in a decision process that is supportable by their analysis, TU urges the BLM to select Alternative A. 0-47-27

<u>The PEIS Does Not Adequately Consider Impacts Associated with Socioeconomic and Environmental Justice</u>

In addition to those impacts that have the potential to affect air, water, fish, wildlife, and climate, the BLM was directed rather strongly to address economic impacts that could occur from the proposed geothermal development activity (EPA letter to BLM, PEIS p. 4-142). However, despite the BLM referencing this EPA letter requesting specific and detailed evaluations of impacts to minority, low-income populations and 0-47-28 disproportionate impacts to these populations, the PEIS falls far short in this endeavor. Many of the 12 western states contain low-income and highly dispersed human populations. Rather than provide any level of even intermediate detailed discussion, only a cursory broad discussion was offered. Additionally, despite requests from the public to include discussion on the economic costs of loss or degradation of public lands, wildlife habitats, quality of life, and hunting and angling, little effort was made to address this issue in the PEIS. O-47-29

On page 4-144 of the PEIS the discussion centers on the economy of building geothermal plants and how bringing in such plants to communities benefits a society. Yet, there is very little comparative discussion on what is lost by the placement of a geothermal plant and associated infrastructure to the land, its wildfire and fisheries, the communities that might be impacted by loss of recreation, tourism, and hunting and fishing opportunities. The conclusion is that some economic impacts may occur should geothermal activity alter ranching, recreation, hunting or mining activities but the overall impact on recreation-related economics would be minimal. There is no supportive data that references these statements, yet individual states have considerable data illustrating the importance of outdoor recreation activities, including hunting and fishing, tourism, etc., and these data should be incorporated into the discussion of impacts in this PEIS. While the geothermal development activity and electrical plant construction may be considered minimal in terms of long-term environmental impacts, it is still incumbent upon the BLM, as part of the NEPA process for evaluating the environmental consequences, to include the loss or reduction of any number of resource activities when approving an incoming resource use.

Finally, the BLM must consider the impacts that could result to the hunting and fishing heritage based on the Executive Order 13443 (August 2007). This Executive Order directs federal agencies that have programs and activities that have a measurable effect on public land management, outdoor recreation, and wildlife management, including the Dept. of Interior and Dept. of Agriculture, to facilitate the expansion and enhancement of hunting opportunities and the management of game species and their habitats. Evaluation of the PEIS's actions have not been conclusive in this document and TU requests that the BLM conduct further analysis on the 12 state region that considers the economic and recreational impacts and values in the BLM's actions. O-47-30

The PEIS Does Not Adequately Address the Cumulative Impacts Associated with Geothermal Development

Other than a cursory and usually one paragraph review of cumulative impacts that geothermal development might have on another resource or resource use, this PEIS does not adequately begin to offer comprehensive cumulative analysis on multiple resource uses. There is virtually no consideration of existing impacts from current oil and gas development, road density, air quality, fragmented wildlife and fisheries habitat, water quality and quantity, or economic activities. The BLM must consider past, present and reasonable foreseeable future actions that are cumulative in nature and result in environmental consequences. The enormity of landmass that is expected to be impacted by geothermal development demands that a much better cumulative analysis be conducted than what has been presented here. O-47-31

Because of the lack of substantial cumulative consideration, TU strongly requests the BLM consider Alternative A, the No Action Alternative, until a more thorough and insightful NEPA analysis is conducted.

Summary

TU has reiterated throughout these comments that the BLM has produced a document that lacks depth in analysis and poorly presented environmental 0-47-32
considerations and consequences from geothermal development. Considerable data and research information is available that would compliment and strengthen this NEPA analysis and TU believes that until the BLM provides better information, they should not approve two scopes of this document--the 19 additional pending applications, and the BLM's Preferred Alternative B. Until a more comprehensive PEIS is completed, TU strongly urges the BLM to choose Alternative A. By choosing the no-action alternative, the impacts to the resource will remain low and a more reasoned decision can be made once the document is supplied with improved and more sufficient information. Thank you for the opportunity to comment on the PEIS.

Sincerely,

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O-47-1

The comment is noted. The analysis in Volume II is commensurate with the scope of the proposed action for the individual leases. During subsequent permitting processes, more site-specific and localized analysis would occur.

O-47-2

The commentor's support for Alternative A is noted.

O-47-3

The impact analysis in Chapter 4 is appropriate for a programmatic-level EIS.

All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis. This document does predict a general level of anticipated future geothermal development in BLM areas that have geothermal potential, but it is not intended to provide full analysis of all phases of development. There are several subsequent stages of decision making necessary to approve geothermal resource development, each with its own environmental compliance requirements, including public involvement, as applicable. This document covers only the land use planning and lease issuance stages.

The RODs for the 19 pending leases are dependant on the ROD for the PEIS and will be signed separately. Therefore, a timing break between the signing of the RODs for the PEIS and the 19 pending leases is not necessary.

O-47-4

The BLM completed final regulations governing geothermal leasing on May 2, 2007 (72 Fed. Reg. 24,358 (2007)).

The analysis in Volume II is commensurate with the scope of the proposed action for the individual leases. During subsequent permitting processes, more site-specific and localized analysis would occur, as appropriate.

The RODs for the 19 pending leases are dependant on the ROD for the PEIS and will be signed separately. Therefore, a timing break between the signing of the RODs for the PEIS and the 19 pending leases is not necessary.

O-47-5

The authorized officer always retains the discretion to reject geothermal lease applications or lease parcels prior to issuance or sale, respectively.

It is also important to note that lands allocated as open are subject to existing laws, regulations, and formal orders, which could prohibit some lands from leasing.

O-47-6

Impact analysis in Chapter 4 is appropriate for a programmatic-level EIS. As noted in the above responses, all development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis. There are several subsequent stages of decision making necessary to approve geothermal resource development, each with its own environmental compliance requirements, including public involvement, as applicable. This document covers only the land use planning and lease issuance stages.

O-47-7

Impact analysis in Chapter 4 is appropriate for a programmatic-level EIS. As noted in the above responses, all development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis.

The RODs for the 19 pending leases are dependant on the ROD for the PEIS and will be signed separately. Therefore, a timing break between the signing of the RODs for the PEIS and the 19 pending leases is not necessary.

O-47-8

The analysis in Volume II is commensurate with the scope of the proposed action for the individual leases. During subsequent permitting processes, more site-specific and localized analysis would occur.

O-47-9

The PEIS does not identify lands for which the FS would or would not consent to the issuance of geothermal leases. For geothermal projects on FS lands, the PEIS would facilitate the subsequent NEPA process that would be necessary to provide future leasing consent decisions.

The existing case law regarding the Roadless Rule is inconsistent. On August 12, 2008, the Wyoming District Court found the 2001 Roadless Rule violated NEPA and the Wilderness Act (State of Wyoming v. US Department of Agriculture). The District Court ordered the 2001 Roadless rule "set aside" and "permanently enjoined." This order is subsequent to a 2006 California District Court ruling that set aside the 2005 State Petitions Rule and reinstated the 2001 Roadless Rule. The United States Justice Department, on behalf of the Department of Agriculture, has filed motions with both the Wyoming and California courts seeking adjustments of those courts' conflicting judicial orders. Neither the Wyoming nor California District Court rulings bar the Department of Agriculture from promulgating other roadless area regulations. To address this inconsistency, the PEIS includes the following Department of Agriculture Roadless Area Stipulation, "If future legislation or regulations change the roadless area designation, the restriction would be revised along with any appropriate environmental review." An appropriate NEPA review would be required prior to any changes to the Roadless Area Stipulation.

O-47-10

Please see the standard response GD1.

As stated in the responses above, all development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis. This document does predict a general level of anticipated future geothermal development in BLM areas that have geothermal potential, but it is not intended to provide full analysis of all phases of development.

O-47-11

The analysis in the PEIS is commensurate with the scope of the proposed action. A broad analysis in the PEIS and differences in the way that land use plans address geothermal leasing and development is a necessary outgrowth of localized characteristics of the resources in the planning area. As noted in the above responses, all development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis. This document does predict a general level of anticipated future geothermal development in BLM areas that have geothermal potential, but it is not intended to provide full analysis of all phases of development.

O-47-12

The comment is noted.

O-47-13

Please see standard responses GD1 and C11.

Additional discussion has been added to the cumulative impact analysis. As noted in Chapter 5, past, present, and reasonably foreseeable actions, including commercial uses of public and federal lands, are documented and analyzed.

As noted above, this document does predict a general level of anticipated future geothermal development in BLM areas that have geothermal potential, but it is not intended to provide full analysis of all phases of development. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis.

O-47-14

Please see standard responses GD1 and L11.

This PEIS allocates areas as being available or closed to geothermal leasing. Stipulations have also been identified that would be applied to protect sensitive resources. Before issuing any leases, the BLM would conduct the necessary review to ensure that leasing would be compatible with the local land use plan and would comply with all applicable Federal, state, and local laws and regulations, such as Endangered Species Act Section 107 consultation and National Historic Preservation Act Section 106 consultation. As noted in Section 2.2.2, there are a variety of stipulations and BMPs that could be applied to protect sensitive issues and conditions.

Moreover, as noted in the above responses, this document is not intended to provide full analysis of all phases of development; all development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis.

O-47-15

Reasonably foreseeable development scenarios have been added for Montana and Wyoming at levels of 20 MW by 2015 and 50 MW by 2025 for each state. No data were available for these states, but the parallel to Colorado was drawn due to the similarity in resource base across the Rocky Mountain Region.

O-47-16

Pleas see standard response WR3.

The analysis in chapter 4 is commensurate with the scope of the proposed action for the PEIS. During subsequent permitting processes, more site-specific and localized analysis would occur.

O-47-17

Please see standard responses WR1 and WR2.

Prior to leasing, the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states typically manage and have regulatory authority for water rights and water quality. Site-specific impacts on water resources would be addressed as part of the environmental analysis for the permitting process. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis. Appropriate site-specific mitigation would be developed, as necessary.

As stated in Section 4-4, impacts of development, utilization, and reclamation of geothermal resources include the potential for groundwater contamination. Appendix D provides BMPs to address methods to minimize contaminations. Federal, state, and local regulations ensure that operators will conduct drilling in a prudent manner. Potential for contamination based on local soil types and groundwater conditions would be assessed prior to issuance of permits for development.

O-47-18

Please see standard responses WR2 and WR3.

As note above, Appendix D provides BMPs to address methods to minimize contaminations. Federal, state, and local regulations ensure that operators will conduct drilling in a prudent manner. Potential for contamination based on local soil types and groundwater conditions would be assessed prior to issuance of permits for development. Water rights are administered and adjudicated at the state level. Each prospective lessee-developer will be required to apply for and obtain an adjudicated state water right before actually attempting to recover geothermal resources (see Section 1.5.1).

O-47-19

Please see standard responses WR2 and WR3.

As noted above, impacts on water quality would be further assessed at the site-specific level. Potential for contamination based on local soil types and groundwater conditions would be assessed prior to issuance of permits for development. Water rights are administered and adjudicated at the state level.

Each prospective lessee-developer will be required to apply for and obtain an adjudicated state water right before actually attempting to recover geothermal resources (see Section 1.5.1).

O-47-20

Please see standard responses WR2 and WR3.

As noted above, impacts on water quality would be further assessed at the site-specific level. Lands designated as open to leasing are subject to existing laws, regulations, and formal orders. In complying with these laws, regulations, and orders, some of the open lands may not be available for leasing. Chapter 2 explains, under *Procedures Prior to Leasing*, that the BLM and FS would comply with the requirements of the Endangered Species Act (ESA), including determining if any listed or proposed threatened or endangered species, or critical habitat, is present on nominated lease parcels and may be affected by any decision to lease. Chapter 6 of the Final PEIS, in turn, explains that the agencies have determined that the decision to lease has no effect on listed species or critical habitat.

To provide further protection for threatened, endangered, and sensitive species, the BLM will impose an ESA stipulation (see Section 2.2.2) on all geothermal leases.

O-47-21

Stipulations provided in this PEIS would serve as the minimal level of protection and would be adopted into local land use plans upon signing of the Record of Decision. For example, if an administrative unit has eligible wild and scenic rivers, the wild river stipulation would apply. If an existing land use plan offers more protective measures or has resource-specific commitments (e.g., memorandum of understanding for cultural resources), those more protective measures would apply instead. Existing land use plans would also be used to help identify locations of applicability, buffer sizes, and timing conditions for the stipulations.

Prior to leasing, the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states typically manage and have regulatory authority for water quality, water rights, and wildlife.

As discussed in Section 1.5.1, water rights are administered and adjudicated at the state level. Each prospective lessee-developer will be required to apply for and obtain an adjudicated state water right before actually attempting to recover geothermal resources (see Section 1.5.1).

O-47-22

Please see standard response WR2.

Air quality is discussed in section 4.8. Water quality is discussed in section 4.4. In this section it is noted that development, utilization and reclamation of geothermal resources may include potential water contamination. Appendix D provides BMPs to address methods to minimize contaminations. Federal, state, and local regulations ensure that operators will conduct development in a prudent manner. Potential for air and water contamination based on local conditions would be assessed prior to permits for development.

O-47-23

Please see standard response C11.

Additional discussion has been added to the cumulative impact analysis. As noted in chapter 5, past, present, and reasonably foreseeable actions, including commercial uses and energy development, on public and federal lands are documented and analyzed.

O-47-24

Please see standard responses GD1 and ESA1.

It is not possible to quantify the impacts to fisheries for projects that are only speculative. There is no reason to assume there will be significant impacts to fisheries from geothermal development. Prior to leasing, the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states typically manage and have regulatory authority for water quality, water rights, and wildlife.

O-47-25

Please see standard response GD1.

Pages 4-73 through 4-92 of the Final PEIS discuss impacts to wildlife that could occur as a result of geothermal development. The impact discussion on page 4-93 provides a national-level comparison, based on which lands would be open and closed, for the alternatives.

The analysis in Chapter 4 is commensurate with the scope of the proposed action for the PEIS.

O-47-26

The PEIS has been modified to include additional climate change discussion for affected resources. Please see the water, soil, vegetation, fish and wildlife, and other resource sections in the Final PEIS.

In addition, discussion has been added to the cumulative impact analysis. As noted in Chapter 5, past, present, and reasonably foreseeable actions, including commercial uses of public and federal lands, are documented and analyzed.

O-47-27

Please see standard responses GD1 and CL1.

As noted above, the PEIS has been modified to include additional climate change discussion for affected resources. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis, including analysis of climate change impacts when appropriate.

O-47-28

Additional text has been added to the socioeconomics sections in Chapter 3 and Chapter 4 to address non-market values.

O-47-29

Additional text has been added to the socioeconomics sections in Chapter 3 and Chapter 4 to address non-market values.

O-47-30

Additional text has been added to the socioeconomics sections in Chapter 3 and Chapter 4 to address non-market values.

O-47-31

Please see standard response CL1.

Additional discussion has been added to the cumulative impact analysis. As noted in Chapter 5, past, present, and reasonably foreseeable actions, including commercial uses of public and federal lands, are documented and analyzed.

O-47-32

The comment is noted.

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September 18, 2008

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RE: Comment by Dunton, LLC concerning Draft Geothermal Leasing Preliminary Environmental Impact Statement ("PEIS").

Dear Ms. Ghali and Folks:

I. Introduction.

This PEIS comment letter is submitted on behalf of our clients: Dunton, LLC; Dunton Hot Springs, Inc., and Christoph Henkel (collectively, "Dunton"). Dunton owns a significant amount of property in the West Fork of the Dolores River in Southwest Colorado and on Lizard Head Meadows within the planning area of the Mancos-Dolores Ranger District of the San Juan Forest ("Forest"). Specifically, Dunton, LLC owns the Dunton Hot Springs Resort, approximately 80 acres size; numerous individual parcels along the West Dolores River ("West Fork"), notably including the 80 acre Emma Mine; 23 acres in small West Fork parcels; the 480 acre Cresto Ranch at the mouth of Johnny Bull Creek ("Cresto Ranch"); an 80 acre in-holding east of Dunton Hot Springs which is traversed by the Fall Creek trail ("Timber Tract"); a 320 acre inholding approximately 4.5 miles southwest of

Lizard Head Peak and approximately 6.5 miles northeast of Rico and adjacent to the Lizard Head Wilderness ("Lizard Head Tract"). Virtually all of these parcels are contiguous to Forest lands, and some are underlain by federally-reserved mineral estates.

The Lizard Head Tract recently received a Private Road Easement following a seven year Environmental Impact Statement process (necessitated by erroneous RARE II classification of the Lizard Head Tract and access road as "roadless area"). The Lizard Head Tract is administratively included within the Lizard Head Roadless Area and is less than one mile from the Lizard Head Wilderness Area. Dunton has not yet constructed the access road across Lizard Head Meadows as authorized by the Private Road Easement.

The Dunton Hot Springs Resort ("Resort") is located at the historic Dunton Townsite, a former hard-rock mining camp. The Resort consists of a collection of historic buildings, now restored, a spa which features the Dunton Hot Springs (with an indoor and outdoor **geothermal** spring), yoga and massage, a bar and restaurant, and numerous outbuildings. The Resort is now considered a luxury, high end tourist accommodation which sees year-round occupancy. The Resort owners and guests frequently (and often independently) recreate in the surrounding San Juan National Forest, enjoying horse-back riding, hiking, cross-country skiing, heli-skiing, snowmobiling, hunting, fishing, bicycle-riding, mushroom foraging, picnicking, photography, wildlife watching, and the like. Dunton Hot Springs, Inc. has an outfitters permit from the USFS for tourist-related hiking and horseback riding in the San Juan National Forest.

Dunton regularly employs approximately fifty employees and independent contractors and provides annual sales tax revenues, payrolls and property taxes in an approximate total amount exceeding $1 Million. Coupled with guest sales and development-related expenditures, Dunton easily generates at least $1.5 Million in direct economic impact to Dolores County, Colorado each year.

Dunton is actively trying to increase its resort business at Dunton Hot Springs and has a business plan aiming to double or triple existing business. The success of this effort will depend in large part on the quality of the guest experience. That experience, in turn, is dependent upon resort amenities, the most significant of which are the Dunton Hot Springs themselves, and the natural beauty, solitude, and relatively pristine quality of the surrounding forest and wildlife. Thus, Dunton's economic future is directly tied to the preservation of the San Juan National Forest Lands in the West-Fork and Lizard Head Meadows area.

The Dunton Hot Springs, Inc. also owns the Paradise Hot Springs adjacent to the Geyser Trailhead. The Geyser is the only **geothermal** mudpot geyser in Colorado. Paradise Hot Springs is a unique **geothermal** hot springs on the West Fork and is occasionally used by friends of the Resort's owner for medicinal and recreational purposes. Christoph Henkel owns a private residence adjacent to the Dunton Hot Springs resort and is the primary owner of the above-referenced entities. Dunton also owns numerous decreed water rights on the West Fork, including **geothermal** water rights, associated with its various properties. Dunton's property includes at least several river miles of the West Fork and property along significant tributaries such as Fall Creek and Johnny Bull Creek. Dunton may be the largest private employer and landowner on the West Fork if not Dolores County.

Dunton believes that the Dunton Hot Springs and Paradise Hot Springs were also used and enjoyed by the Ute Indians and their predecessors.

Dunton conceived and financed the extension of high speed internet service up the West Fork. Dunton has previously been actively engaged in various Forest service proposals and projects, including comment on the proposed expansion/upgrade of Dolores County Road 38 (since abandoned), the Geyser Trail trailhead relocation proposal (since modified and mitigated), the recent Travel Management Plan update proposal, and the draft Resource Management Plan amendment. Dunton has informally discussed several potential land exchanges with Forest personnel over the years, including the Lizard Head Tract.

Dunton welcomes this opportunity to comment on the PEIS. By virtue of its land and water right holdings, demonstrated history of involvement with the Forest Service, extensive use of Forest lands, and economic benefit to the West Fork and Dolores County, Dunton considers itself to be a major stakeholder in the LMP revision process. C-48-1

II. Inadequate Analysis of Potential Impacts to Existing Geothermal Resources and Inadequate Analysis of Possible Avoidance/Mitigation of Impacts.

As an owner of two surface geothermal springs and related water rights with high economic value, Dunton would like to see the PEIS take a more proactive approach in evaluating potential impacts to existing geothermal and water resources and related tourist-resort resources. Such impacts will necessarily result from "expediting" geothermal leasing and consequential exploration and development of the 242 geothermal commercial electric generation plants anticipated by 2025, each of which could occupy 55 to 374 acres (Executive Summary, pp 7, 8, 10). C-48-2

Dunton expressly incorporates and strongly endorses the comments set forth in the 3 September 2008 letter to Mr. Ghali Re: Comments on the Draft PEIS for Geothermal Leasing in the Western United States submitted by Mr. Wayne Goin of Minion Hydrologic (the "Minion Letter"). A hard copy of such letter is also enclosed herewith. Specifically, Dunton supports the concepts of a limitation of geothermal exploration within a one-mile area around existing geothermal resources, such as the Dunton and Paradise Hot Springs, and a requirement for notification of decreed geothermal water right owners within two miles of the proposed geothermal development. C-48-3

The PEIS itself provides precedent for such a proposal: alternatives address protecting both the 14,000 acre Island Park Geothermal Area as a buffer around the south and west boundaries of Yellowstone National Park, and a 15 mile buffer around the entire Yellowstone Park. Given the recognition of the obvious need for protection of this most famous geothermal resource, it is curious that the PEIS is almost devoid of any substantive discussion of the need to protect other known, valuable geothermal resources and hot springs as well.

Furthermore, there is precedent for protection of other resource values in requiring a substantial no-surface occupancy buffer for geothermal leases. See Evans-Barton, Ltd., IBLA 2008-17, wherein a geothermal lease stipulation prohibiting surface occupancy within a half-mile area around a privately-owned hot springs site considered to be sacred by Indian tribes, was upheld on appeal.

Dunton participated in the 2004 State of Colorado geothermal rulemaking by the Colorado Division of Water Resources, Office of the State Engineer, which resulted in the current "Rules and Regulations for Permitting the Development and Appropriation of Geothermal Resources Through Use of Wells, 2 CCR 402-10 (the "Geothermal Rules"). C-48-4

The Geothermal Rules provide for notice to owners of decreed water rights within half a mile of a location for which certain geothermal wells are applied for. See, e.g., Geothermal Rules 6.2.3.3. Such owners are accorded a right of objection to an application for a geothermal well permit. While the Rules do not provide for such notice where there is a closed loop system, in Dunton's opinion the risk to existing geothermal resources is identical during the drilling phase. A more protective procedure should be adopted at the federal leasing level.

Among the "general adverse impacts" that the PEIS describes would result from commercial geothermal development, are "*short-term* impacts to ground water *during drilling*". The PEIS fails to adequately describe such impacts, and arbitrarily assumes without evidence that such groundwater impacts would be both short-term, and confined to drilling. The Minion letter documents with existing case studies just how wrong these assumptions are, and demonstrates the potential for intermixing of geothermal and other waters, potential artesian results, and diminution of both flow and temperature of existing geothermal features. Thus, the PEIS understates the potential risk for damage to existing groundwater resources from geothermal development. C-48-5

III. Federally-Reserved Mineral Estates (Split Estates) Do Not Necessarily Include Geothermal Rights.

The PEIS Executive Summary states at ES 1Introduction, without qualification, and without citation of authority, that "a geothermal lease is for the earth's heat resource, *where there is a federal mineral estate*." C-48-6

This assertion is not supported by any citation to authority of any of the various mining acts, homestead, or other federal land disposal laws, in which mineral estates were actually reserved from lands sold to miners or homesteaders that are now owned by different owners. These laws and their concurrent interpretation will control the answer to the question of whether there is any federal right to issue a geothermal lease for exploration and development of the earth's heat resource, language that is absent from most such reservation laws.

One federal case apparently construed the Stock-Raising Homestead Act, and concluded that geothermal energy was included in a reservation of "other minerals". No such authority apparently exists with respect to other reservations under other disposal laws.

Moreover, this assertion - in the guise of an initial definition of a geothermal lease – of geothermal lease issuance authority extending over all not only all federal lands but also federally-owned split mineral estates under private lands, assumes a federal ability to lease for extraction of the earths' heat resource anywhere there are other federal mineral interests or values that have been reserved, regardless of the general or specific nature of the reservation involved based on the succession of public lands laws in effect at the time of the federal reservation. Such a statement is wholly unsupported. Since extraction of geothermal waters involves not mineral rights but water rights, see below, such extraction right is not part of a federally-reserved mineral estate. C-48-7

If federal split mineral estates were excluded from the PEIS analysis in whole or in part as eligible for issuance of a federal geothermal lease, an entirely different description of the extent of the resource, source of impacts, and possibility of mitigation would result. As such the overbroad assumption of the scope of federal geothermal leasing authority has caused vast but unquantified overstatement of the potential energy production benefit of the federal geothermal leasing program. This issue should be addressed in detail, with supporting authority, in any final EIS.

Existing BLM regulations governing disposal of federally-reserved mineral estates define mineral values as follows:

> **[M]ineral values in lands with underlying geologic formations which are valuable for prospecting for, developing or producing natural mineral deposits. The presence of such mineral deposits in the lands may be known, or geologic conditions may be such as to make the lands prospectively valuable for mineral occurrence.**

43 CFR 2720.0-5

A federally-reserved mineral estate whose values are defined as consisting solely of natural mineral deposits, cannot include other non-defined values, such as heat from the earth.

In Colorado, geothermal rights which involve extraction, diversion or release of tributary geothermal waters, legally are water rights, not mineral rights. Water C-48-8 rights are defined by C.R.S. 37-92-103(12) and means the right to use in accordance with its priority a certain portion of the waters of the state by reason of the appropriation of the same. The appropriation of geothermal fluids to recover geothermal resources is recognized as a beneficial use of ground water subject to state administration. C.R.S. 37-90.5-107.

In the event of issuance of a federal geothermal lease on a split estate created pursuant to an act other than the Stock Raising Homestead Act, without a prior judicial determination of federal ownership of the geothermal right, the federal government may be exposed to liability to claims for inverse condemnation, trespass, and other damages.

Water is not a mineral, and the law of minerals and property ownership is inapplicable to water and water use rights. See Board of County Comm'rs of the County of Park v. Park County Sportsmen's Ranch, LLP, 45 P.3d 693 (Colo. 2002). As such, geothermal rights involving wells or diversion or re-injection of geothermal waters are subject to the Colorado water rights administration system, and Colorado or applicable laws re: surface access, entry and occupancy. As water rights, these types of geothermal resources are not within the federally-reserved mineral estate and are not available for federal lease.

The BLM and FS should evaluate the potential effect of the widespread geothermal development anticipated by the proposed action alternative, upon the *federally-reserved water rights* that were created at the time of creation of national forests, parks, monuments and other federal lands. No such analysis appears.

IV. Lease Stipulations Are Inadequately Protective.

Section 2.2 discusses potential Lease stipulations that would be applied as "appropriate". Despite language at page 2-15 suggesting the stipulations would be the "minimal level of protection", elsewhere the PEIS does not clearly mandate the inclusion of specific stipulations in geothermal leases, but rather leaves that decision wither to subsequent Resource or Forest Plan amendment of lease issuance. Moreover, there is no basis to assume the presence or appropriateness of such general stipulations in subsequent leasing, nor is there a basis to describe the impacts of geothermal development by assuming the presence of or compliance with such stipulations. We suggest that the one-mile buffer area from existing C-48-9 decreed geothermal water rights described above, be included as a mandatory major constraint that must be included in all leases.

The similarity of oil and gas drilling exploration and development impacts to geothermal development are recognized in this section. This is somewhat troublesome, as current federal oil and gas leasing practice in Colorado suggests that if a stipulation (such as no surface occupancy) is not specifically prescribed for a specific area in a Resource Management Plan, then such a stipulation may not be imposed upon a lease for a parcel nominated by the oil and gas industry. Moreover, the surface owner is not individually notified when an oil and gas lease is proposed for lease auction. See: 12/14/05BLM Split Estate Report, Energy Policy Act of 2005, Section 1835, Split-Estate Federal Oil and Gas Leasing and Development Practices C-48-10

"Protective Leasing Stipulations:
BLM notifies the public of their opportunity to participate and comment on the preparation of land use plans and amendments. BLM does not specifically notify individual surface owners that land use planning decisions are being made which could affect the oil and gas development actions on their surface. (Planning decisions include: No Lease; Lease with Standard Terms and Conditions; Lease with Major Constraints; Lease with Moderate Constraints; and are typically based on resources such as wildlife, steep slopes, wetlands.)

BLM does not apply any stipulations specific to split estate.

We recognize that the PEIS at p2-28 suggests protection of existing geothermal features through stipulations. Such stipulations are not summarized or characterized at all, let alone with sufficient detail that an assessment of overall national or regional impacts to existing geothermal resources under any of the alternatives is even possible. C-48-11

Without inclusion of an adequate nationwide survey of existing geothermal features and hot springs, a nationwide or programmatic environmental impact statement is unable to systematically characterize the potential impacts to these vital resources. C-48-12

Significantly, the proposed stipulations would not require monitoring of nearby geothermal features that are outside of the geothermal lease area. The potential impact of such an arbitrary segregation is not even discussed.

Dunton supports the proposed stipulation against new roads for geothermal development in inventoried roadless areas, such as the area surrounding the Lizard Head Meadows Tract. C-48-13

V. Conclusion.

Overall, the PEIS is an over-hasty attempt to "facilitate" and "expedite" federal geothermal leasing. In doing so, the PEIS has simplified the analysis and avoided the hard look at geothermal development impacts and possible constraints and mitigations on 117 million acres of BLM land and 25 million acres of USFS lands (non-Alaskan) that would be newly-opened to geothermal leasing. Dunton believes a case by case review needs to be conducted before declaring any federal land open to geothermal development, particularly near existing geothermal features. C-48-14

Absent appropriate supplementation, the PEIS overall fails to meet NEPA requirements for comprehensive description and analysis of impacts to and potential mitigations of existing geothermal resources. Dunton asks that an approach that is highly protective of existing public and private geothermal features and hot springs, and which recognizes that the federally-reserved split estates do not automatically include the right to extract geothermal waters or heat, be adopted in all further environmental review of geothermal development.

Thank you for the opportunity to comment. We request and look forward to receiving notice of all future documents and decisions related the PEIS.

Very Truly Yours,

Stephen B. Johnson Law Firm, P.C.

Stephen B. Johnson

Stephen B. Johnson

Encl.
c. C. Henkel
W. Goin

C-48-1

The BLM and FS note the commentor's role as a stakeholder for this project.

C-48-2

Specific impacts on water resources are more appropriately analyzed at the site-specific level due to variation in the resource by location. Prior to leasing, the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states typically manage and have regulatory authority for water quality, water rights, and wildlife. Site-specific impacts on water resources, including groundwater, would be addressed as part of the environmental analysis for the permitting process. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis, including public involvement, as appropriate. The BLM and FS would work with interested and affected parties to identify and resolve user conflicts. Appropriate site-specific mitigation would be developed, as necessary.

C-48-3

As discussed in Section 1.5.1, geothermal leasing is guided by law (e.g., Geothermal Steam Act) and regulations, including the recently revised geothermal leasing and development regulations (43 CFR 3000, 3200, and 3280). The PEIS is not proposing to amend or change any of the laws or regulations. While the BLM manages the geothermal resource (namely the heat), the state has primacy over the associated water resource. In accordance with state regulations, a lessee/operator will be required to apply for and obtain an adjudicated state water right before actually attempting to recover geothermal resources.

Given that impacts on geothermal resources from adjacent development may vary based on site-specific conditions, no specific buffer zone has been established for leasing in the PEIS.

C-48-4

As stated above, geothermal leasing is guided by law (e.g., Geothermal Steam Act) and regulations, including the recently revised geothermal leasing and development regulations (43 CFR 3000, 3200, and 3280). The PEIS is not proposing to amend or change any of the laws or regulations. Addressing site-specific issues is evaluated during the subsequent permitting process. The BLM and FS can apply conditions of approval on such permits to avoid and minimize any impacts to specific resources. While the BLM manages the geothermal resource (namely the heat), the state has primacy over the associated water resource. In accordance with state regulations, a lessee/operator must secure permits from the state before the BLM can issue a permit to drill either a temperature gradient well or a full-diameter exploration well.

C-48-5

Cement and casing of the well bore is designed to prevent mixing of reservoir zones. Although older casings can leak (more often in reinjection wells than production wells), they are inspected and tested to prevent this occurrence at regular intervals, and can be repaired. As stated in Section 4-4, impacts of development, utilization, and reclamation of geothermal resources include the potential for groundwater contamination. Appendix D provides BMPs to address methods to minimize contamination. Federal, state, and local regulations ensure that operators will conduct drilling in a prudent manner. Potential for contamination based on local soil types and groundwater conditions would be assessed prior to issuance of permits for development.

C-48-6

As discussed in Section 1.5.1, geothermal leasing is guided by law (e.g., Geothermal Steam Act) and regulations, including the recently revised geothermal leasing and development regulations (43 CFR 3000, 3200, and 3280). In addition, please see U.S. v. Union Oil Co. of California, 549 F.2d 1291 (9th Cir. 1977) and Rosette v. United States, 277 F.3d 1222 (10th Cir. 2002) and Rosette v. United States DOI, 142 N.M. 717, 169 P.3d 704 (2007) for decisions related to the authority of the federal government to issue leases for geothermal resources.

Disputes over land title issues are outside the scope of this PEIS.

C-48-7

As stated above, geothermal leasing is guided by law (e.g., Geothermal Steam Act) and regulations, including the recently revised geothermal leasing and development regulations (43 CFR 3000, 3200, and 3280). The PEIS is not proposing to amend or change any of the laws or regulations. Addressing site-specific issues is evaluated during the subsequent permitting process. The BLM and FS can apply conditions of approval on such permits to avoid and minimize any impacts to specific resources. While the BLM manages the geothermal resource (namely the heat), the state has primacy over the associated water resource. In accordance with state regulations, a lessee/operator must secure permits from the state before the BLM can issue a permit to drill either a temperature gradient well or a full-diameter exploration well.

Disputes over land title issues are outside the scope of this PEIS.

C-48-8

BLM Field Offices collaborate closely with appropriate state agencies, especially in the case of geothermal energy, where the states manage and have regulatory authority for water quality and water rights. New text was added to *Procedures Prior to Leasing* in Chapter 2 on coordinating with state agencies.

Please see response to C-48-6 for laws and court decisions guiding geothermal leasing.

C-48-9

Stipulations would be applied to a land use plan if an administrative unit has the relevant features related to the stipulation (i.e. areas with wild and scenic rivers would have the wild and scenic rivers stipulation applied). Should an exception, waiver or modification occur, the BLM would analyze and document how the exception is in conformance with the land use plan.

Setbacks, if any, from an adjudicated water right would be determined on a case-by-case basis. As states in the above responses, geothermal leasing is guided by law and regulations; the PEIS is not proposing to amend or change any of the laws or regulations. Addressing site-specific issues is evaluated during the subsequent permitting process. The BLM and FS can apply conditions of approval on such permits to avoid and minimize any impacts to specific resources.

C-48-10

The intent of the Proposed Action (specifically Section 2.2.2 *Lease Stipulations*) is to identify specific stipulations and the conditions that would trigger the application of the stipulations. After the Record of Decision, the 120 plans identified in the Final PEIS would be amended to incorporate the stipulations. Thus, if an area has a specific condition, then the appropriate stipulation would be applied (e.g., slopes over 40 percent would have a NSO stipulation). All lease sales will follow the leasing regulations.

C-48-11

Information is included in other *Lease Stipulations-Protection of Geothermal Resources* in Section 2.2.2.

C-48-12

As noted in the comment responses above, site-specific impacts on water resources, including groundwater, would be addressed as part of the environmental analysis for the permitting process. The BLM and FS would work with interested and affected parties, including other geothermal resource users, to identify and resolve user or resource conflicts. Appropriate site-specific mitigation would be developed, as necessary. Additionally, each prospective lessee-developer will be required to apply for and obtain an adjudicated state water right before actually attempting to recover geothermal resources (see Section 1.5.1).

C-48-13

The commentor's support for the proposed stipulation is noted.

C-48-14

The comment is noted.

geothermal_eis

From: Mary_Christensen@blm.gov [Mary_Christensen@blm.gov] **Sent:** Thu 9/18/2008 3:20 PM
To: geothermal_eis
Cc:
Subject: Mail forwarded from geothermal_eis@blm.gov
Attachments: GeothermalReferenceMapMTH.pdf(590KB) GeothermalReferenceWill.pdf(184KB)

This message has been automatically forwarded from geothermal_eis@blm.gov.

Doug Heiken <dh@oregonwild.org>
Sent by: Doug Heiken <dh.oregonwild@gmail.com>
09/18/2008 04:17 PM

Please respond to Doug Heiken <dh@oregonwild.org>

To geothermal_eis@blm.gov
cc
bcc
Subject Oregon Wild comments on the Geothermal Leasing Draft PEIS

Please find attached comments on the geothermal DEIS and maps showing relevant management constraints for proposed leases on the Mt Hood NF and Willamette NF.

--
doug's signatureDoug Heiken
Conservation and Restoration Coordinator
Oregon Wild formerly Oregon Natural Resources Council (ONRC)
Protecting Oregon’s wildlands, wildlife and waters since 1974.
PO Box 11648 | Eugene OR 97440
541-344-0675

nder "reasonably foreseeable development scenario is says: "It is expected that a 30-megawatt plant would result in 15 acres of land disturbance, and a 20-megawatt plant would result in 10 acres of land disturbance, for a total disturbance of 25 acres. Existing Forest Service roads would be used to access the sites. Portland General Electric acknowledges that while over 9,000 acres of land are included in the lease area, most of the land is not feasible to develop due to proposed wilderness areas, river riparian setbacks, steep slopes, cliffs, wilderness areas, ski areas, and protected watershed for The Dalles. Exploration activities for a 20-megawatt plant and a 30-megawatt plant are expected to involve approximately 12 temperature gradient holes, disturbing approximately 0.15 acre each, for a total disturbance of approximately 2 acres."] [This application was filed in 1974.] Energy Policy Lacking. The United States lacks a coherent energy policy ? simultaneously pursuing and subsidizing many different non-renewable and renewable energy sources in a haphazard fashion. We strongly urge the development of a comprehensive energy policy that integrates concerns over prices, consumer access, diversity of supply, national security, and environmental impacts including climate change impacts. Geothermal energy is subsidized through renewable energy portfolio standards, renewable energy tax credits, and by granting private parties access to public land and allowing them to degrade public values like clean water, wildlife habitat, and scenic beauty. These are not to be taken for granted. Climate Change We recognize the threat that climate change poses to earth systems, natural systems and human systems, and we share a strong desire to develop energy sources with smaller carbon footprints. Geothermal might be part of a comprehensive plan to avoid and mitigate climate change, but we have not seen the national policy commitment necessary to make a real difference. We are not too enthused about sacrificing public lands in order to develop geothermal energy if it will only reduce the rate of growth in demand for energy under a business-as-usual scenario. It would be much better if geothermal was helping to reduce absolute demand for energy and reducing dependence on fossil energy sources under a strong energy policy that emphasizes conservation and renewable energy. Scope of approval is too broad Basically two thirds of Oregon is proposed to be eligible for geothermal leasing. The area recognized for its geothermal potential is so big and broad that it fails to offer any guidance on places that are more appropriate and less appropriate for development. An important purpose of this analysis and decision should be to point developers toward sensible and less environmentally and sensitive areas, such as already degraded areas near existing power lines and roads. Approval Criteria We urge the government to adopt stringent approval criteria that will avoid impacts to inventoried roadless areas, uninventoried roadless areas, mature & old-growth forests, Late Successional Reserves, Key Watersheds, Municipal watersheds, administratively withdrawn areas, riparian areas, carbon stored in ecosystems and soil, habitat for threatened & endangered and other sensitive wildlife, ACEC, wild & scenic rivers, wildlife refuges, scenic areas. It is vital to carefully avoid and minimize impacts from all aspects of the geothermal development process, including exploration, new power distribution lines, access roads, staging areas, as well as production wells and generating facilities. The decisions resulting from the NEPA analysis must not grant carte blanche approval for lease sales. The analysis must be used to develop priorities where geothermal lease sales will be favored and areas where lease sales will be disfavored. The sensitive resource areas listed above should be generally disfavored. Failure to Consider All Reasonable Alternatives The EIS failed to consider

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alternative criteria and mitigation that would better protect the environment. Such as those suggested in this letter. The EIS underestimates impacts. The EIS estimates that road access will impact 32 acres or less. Most of the proposed facilities in Oregon are likely to be in extremely remote areas, requiring extensive road construction. Furthermore, road impacts are not limited to the roadway itself. Roads have extensive edge effects, hydrologic effects, weed effects, and wildlife disturbance effects that radiate far beyond the road prism. The EIS described old growth forests in the ?affected environment? section but fails to adequately disclose the impacts of geothermal development on these resource in the ?environmental consequences? section. The EIS seems to rely on the Northwest Forest Plan standards & guidelines for Late Successional Reserves (LSRs) to mitigate for the effects of leasing on the LSRs in the Mt Hood and Willamette NFs, but the EIS does not actally put the rubber to the road and apply the standards & guidelines to the specific geothermal proposals. One of the purposes of NEPA is to explain how proposed federal actions will comply with environmental standards, but this was not done. The EIS assumes that the National Forest roadless rule will be followed (no new roads in IRAs) but the EIS fails to disclose the adverse consequences if the Bush administration and their pro-extraction allies succeed in their ill-advised legal challenges to the National Forest roadless rule. The EIS also assumes that old growth forests will continue to be protected under the Northwest Forest Plan, but the EIS fails to recognize that the BLM itself has proposed the Western Oregon Plan Revision (WOPR) which would severely undermine the overall scheme of the Northwest Forest Plan and the protection it affords to old growth forests and LSRs. Even if the WOPR does not propose to directly change the rules for managing LSRs on the National Forests, the WOPR sill undermines the efficacy of the Northwest Forest Plan on the National Forests and its ability to conserve a functional and inter-connected old growth ecosystem as intended. The FS relies on BLM to do its part and maintain old growth habitat along critical connective areas between the different mountain ranges. The EIS completely misunderstands the Western Oregon Plan Revision. The EIS says, ?The Bureau of Land Management is currently revising the Salem RMP to align it with the Northwest Forest Plan.? The WOPR is NOT about alignment. It?s about BLM disengaging from the Northwest Forest Plan. See ONRC?s scoping comments on the WOPR. ‼ HYPERLINK "http://www.oregonheritageforests.org/resources/BLM_WOPR_ONRC.doc" ¶ http://www.oregonheritageforests.org/resources/BLM_WOPR_ONRC.doc┴ Page 4-67 of the EIS says that most sensitive and high quality old growth habitat is off-limits to geothermal development because it is located in ACECs, wilderness, and roadless areas. This is false, false, and false. First, BLM has completely abdicated it?s responsibility to identify extensive high-quality old growth forests as ACECs. See Oregon Wild?s recent proposal for an extensive network of old growth ACECs which was rejected by BLM ‼ HYPERLINK "http://www.oregonheritageforests.org/resources/WOPR_Indyla_ACEC.doc" ¶ http://www.oregonheritageforests.org/resources/WOPR_Indyla_ACEC.doc┴ Second, wilderness areas generally were establish in high-elevation areas with mostly rock and ice and small trees, not in the low-elevation areas with large old growth favored by both the timber industry and endangered species. Third, after decades of dispersed clearcutting and road building, the few remaining inventoried roadless areas are too small to provide functional old-growth ecosystem. Most of the remaining old-growth is either in Late Successional Reserves, riparian reserves, or matrix and are not off

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limits under this geothermal proposal, though they should be and we urge
the government to take the steps necessary to protect the last remaining
old growth forests. The EIS indicates that some mature & old-growth forest
that provides suitable habitat for the Northern Spotted Owl would be
destroyed in pursuit of geothermal resources on the Mt Hood and Willamette National Forests. O-49-10
The EIS falsely assumes that the NWFP functions as a
recovery plan for the owl (EIS p 16-33) and fails to recognize the
requirements of the final recovery plan for the Northern Spotted Owl
(especially recovery action #32) which requires among other things that
substantially all of the high quality spotted owl habitat be protected. See
USFWS. 2008 Final Recovery Plan for the Northern Spotted Owl. ‼ HYPERLINK
"http://www.fws.gov/pacific/ecoservices/endangered/recovery/NSORecoveryplanning.htm" ¶
http://www.fws.gov/pacific/ecoservices/endangered/recovery/NSORecoveryplanning.htm┴
The use of groundwater during geothermal development will alter springs
and surface water with significant impacts on aquatic organisms such as O-49-11
fish, aquatic insects, herptiles, and mollusks. The analysis of leases in
Oregon is inadequate. Chapters 15 and 16 in the EIS are like mini-EISs
within the PEIS. The NEPA analysis of proposed site-specific leases in the O-49-12
Mt Hood National Forest and the Willamette National Forest are inadequate
to support an informed decision whether to approve or reject those
applications. The EIS does not adequately describe the location of the
ground-disturbing activities, the conditions at those sites, all the
sensitive ecological resources at those sites, and the site-specific
ecological impacts at those sites. The reasonably foreseeable development
scenario is merely a hypothetical, so the location and effects of O-49-13
development activities are hypothetical. Actual effects may vary. Actual
effects of a poorly located geothermal energy project could be worse than
described under the reasonably foreseeable development scenario. Further
NEPA analysis will be needed to compare diferent concrete development
proposals and make an informed decision based in the real world. We are
concerned about combining the programmatic EIS and lease-specific EISs. In
promoting this as a Programmatic EIS, many people may not be aware of the O-49-14
local project-specific nature of the proposals for the Willamette and Mt
Hood National Forest. If these projects are approve and developed many
people are going to be surprised. The proposed leases near Mount Hood have
the following problems that should be avoided or mitigated: - Small piece in
an IRA (Bluegrass Ridge addition to Mt Hood Wilderness, FS supports as O-49-15
Wilderness) - Includes lands to be designated as Wilderness by the Lewis and
Clark Mount Hood Wilderness bill. - Includes lands that are in the drinking
watershed of Hood River - Includes lands that are in the drinking watershed
of the city of The Dalles - Overlaps the Wild and Scenic East Fork Hood
River (part of Lewis and Clark Hood bill). - Overlaps Late Successional
Reserve. - Likely other concerns as well. The proposed leases on the
Willamette National Forest have the following problems that should be O-49-16
avoided or mitigated: - Overlaps the Mt Jefferson North IRA - Overlaps Mount
Bruno unroaded area - It's entirely within an LSR. - Likely other concerns as
well. The EIS does not adequately analyze the effect of geothermal
development on the 9 Aquatic Conservation Strategy objectives set forth in O-49-17
the Northwest Forest Plan. The EIS does not adequately describe how
geothermal development will affect the attainment of objectives for Late
Successional Reserves which are to protect and enhance late successional O-49-18
forest conditions (NWFP ROD p C-9, C-11,). Generally, removal of trees >80
years old is not allowed in LSRs (NWFP ROD p C-12). Activities other than
silviculture in LSRs must be ?neutral or beneficial? to late successional
habitat. (ROD p C-16). ?Developments? in LSRs must be planned so as to have

the ?least possible adverse impacts? on LSRs. The potential benefits of new roads in LSRs must exceed the costs of habitat impairment (C-16). Project ?locations? must be chosen to ?avoid? degradation of habitat (p C-17). Removing late successional forests to make way to geothermal development does not seem consistent with those objectives. The EIS also failed to consider the ?management assessments? for the affected LSRs. EIS at pages 15-32 and 15-33 is contradictory. It says that old-growth is both protected by the Northwest Forest Plan and would be removed. The analysis of recreation impacts ignores all recreation occurring outside of officially designated recreation areas. In fact, the Mt Hood NF is located near a large population center (Portland/Vancouver) and virtually the entire forest is used for recreation at various times and intensities. Given the large nearby population center the Mt Hood NF is considered to be crowded. Remote areas where visitors can find solitude are even more rare and valuable. The supposedly site-specific analysis in Chapters 15 and 16 frequently refers to the generic description of effects on the programmatic EIS. The site-specific EIS needs to describe the effects of specific actions at specific locations not generically. The EIS does not disclose the effects of energy transmission corridors. Page 16-9 says that ?The length and alignment of transmission lines are not estimated here since these factors would depend upon the positioning of any power plant and the distance to the nearest electrical tie-in.? This is not adequate to support a supposedly site-specific NEPA analysis. In describing lease areas on the Willamette NF, the EIS (p 16-13) says ?land use is primarily limited to forestry and recreational use.? This ignores other important uses such as clean drinking water for the city of Salem Oregon, wildlife habitat, carbon storage, soil stability, nutrient cycling. The EIS needs to think in terms of ecosystem services, not just traditional human uses that occur in situ. Climate change It would be helpful if the EIS analysis of climate impacts would disclose the amount of fossil fuels that might be offset by specific proposals in Chapters 15 and 16 and compare that to the amount of fossil fuels that would need to be offset in order to reach targets for climate stabilization. On the other hand, the analysis should also disclose how much greenhouse gases would be released from native ecosystems disturbed by geothermal development and by fossil fuels used to design, manufacture, and build geothermal facilities. Please disclose whether proposed geothermal development will help meet increasing demand, or whether it will off-set fossil fuels in an atmosphere of declining energy use. If energy use continues to increase, adding a little geothermal to the mix is like slightly delaying the sinking of the Titanic. The authorized officer must retain the right to reject applications that are not in the public interest. The EIS says ?The authorized officer retains thediscretion to issue leases with stipulations that impose moderate to major constraints on use of surface of any leases in order to mitigate the impacts to other land uses or resources objectives as defined in the guiding resource management plan.? The government must retain even more rights that this. The must retain the right to outright reject projects that are not in the public interest. A programmatic EIS is simply not detailed enough to say that projects on almost 200 million acres can proceed with mitigation. N some cases, mitigation will not be enough and the authorized officer must retain the right to reject geothermal applications. Future NEPA analysis The DPEIS says, ?it is the intent of the BLM that, upon receipt of future nominations or applications for direct use, affected BLM offices would be able to conduct a DNA evaluation to make lease sale decisions without further plan amendments or NEPA analysis ? But this is contradicted by the following:

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O-49-25

?The PEIS does not evaluate site-specific issues associated with geothermal exploration, drilling, utilization, or reclamation and abandonment. A variety of location-specific factors (e.g., soil type, watershed, habitat, vegetation, viewshed, public sentiment, the presence of threatened and endangered species, and the presence of cultural resources) varies considerably from site to site, especially over the 12-state project area.? We feel strongly that this programmatic NEPA analysis must be followed by rigorous site-specific NEPA analysis and that DNAs will not be enough. Given the variation in location-specific factors across the region and the fact that we don?t know what location any given geothermal facility will occupy, or the route that new access roads and transmission lines might follow, specific environmental effects of geothermal development cannot be captured in a programmatic EIS. Impacts on native ecosystems are not fully recognized. The Draft EIS says ?Reclamation is done on areas that are no longer needed for these activities, so the actual area of disturbance for O-49-26
an operating power plant is generally much less.? This ignores the consequences of exploration or other ?temporary? impacts that may affect old growth forests or other ecosystems in ways that are essentially irreversible. The EIS seems to assume falsely that all impacts are reversible, but they are not. Spreading weeds is essentially an irreversible effect. Page 4-67 of the EIS recognizes that removal of old growth forests is an irreversible impact, but the EIS falsely assumes that most of the high quality old growth is off limits to development. The analysis must be redone to acknowledge the real long-term impact of effectively irreversible development activities. Building roads for exploration or other purposes is another example of an essentially irreversible impact. Unavailable Lands for Geothermal Leasing BLM and the USFS are way behind the times in terms of identifying lands that should be off-limits to development. These agencies have an inherent conflict of O-49-27
interest in favor of economic exploitation of the lands under their control, while failing to take reasonable steps to protect and conserve the public vales that the American people expect from those lands. ?Public good? like clean water, wildlife habitat, biodiversity, public recreation areas, and carbon storage, are chronically under-produced because of the externalities which prevent landowners from capturing the economic value of those shared resources. Luckily these are public lands and the public can assert themselves to correct those market imperfections caused by externalities. BLM and the USFS should place more lands off-limits to development in order to ensure adequate production of under-produced ?public goods.? Sincerely, Doug Heiken

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O-49-1

The document was prepared in accordance with the Energy Policy Act of 2005 (see Section 1.8.1).

It is outside the scope of this document to amend the policy established by Congress.

O-49-2

The comment is noted.

O-49-3

The authorized officer always retains the discretion to reject geothermal lease applications or lease parcels prior to issuance or sale, respectively.

Before issuing any leases, the BLM would conduct the necessary review to ensure that leasing would be compatible with the local land use plan and would comply with all applicable Federal, state, and local laws and regulations, such as Endangered Species Act Section 107 consultation and National Historic Preservation Act Section 106 consultation. As noted in Section 2.2.2, there are a variety of stipulations and BMPs that could be applied to protect sensitive issues and conditions.

O-49-4

As noted in the above response, the authorized officer always retains the discretion to reject geothermal lease applications or lease parcels prior to issuance or sale, respectively.

Before issuing any leases, the BLM would conduct the necessary review to ensure that leasing would be compatible with the local land use plan and would comply with all applicable Federal, state, and local laws and regulations, such as Endangered Species Act Section 107 consultation and National Historic Preservation Act Section 106 consultation. In addition, there are a variety of stipulations and BMPs that could be applied to protect sensitive issues and conditions.

Please see response to comment O-49-8 for a detailed response to the roadless areas component of this comment.

O-49-5

In accordance with 40 CFR Section 1502.13, the purpose of and need for the proposed action is used to define a range of reasonable alternatives (purpose of and need for action is defined in Sections 1.2 and 1.3). The BLM is making an allocation decision here, and adopting a list of stipulations, BMPs, and compliance procedures to be incorporated in the land use plans. The PEIS analyzes in detail the Proposed Action, a No Action alternative, and the Leasing Near Transmission lines alternative. The Final PEIS incorporates input from public comments on the Proposed Action. Another alternative considered but eliminated from detailed study included no leasing or development of geothermal resources on public or NFS lands (Section 2.4.1). As explained in Section 2.4.1, this alternative, which would have been the most protective (from a ground disturbance standpoint), was eliminated because it would violate the multiple use provisions of FLPMA and is inconsistent with the President's National Energy Policy, the Energy Policy Act of 2005, and Executive Order 13212 and would not have fulfilled the purpose and need for the proposed action. The alternatives analyzed represent a range of acreages as potentially available for leasing. See CEQ's *Forty Most Asked Questions Concerning the CEQ's NEPA Regulations*, Question 1b ("When there are potentially a very large number of alternatives, only a reasonable number of examples, covering the full spectrum of alternatives, must be analyzed and compared in the EIS.") In particular, the Leasing Near Transmission Lines alternative was developed based on public scoping comments to represent a limited development alternative. Instead of inventing a variety of alternatives that would lie between the alternatives presented, the BLM and FS elected to include protective measures (i.e., stipulations, BMPs, and compliance procedures) in each of the action alternatives. Further, those planning areas whose plans include more protective measures may elect to keep those measures in place, instead of the stipulations, BMPs, and compliance procedures presented in the Final PEIS.

O-49-6

The level of road construction required is likely to vary by location. The RFD discusses the general level of impacts. Prior to development and utilization, further site-specific environmental analysis and permitting will be required.

O-49-7

The analysis of impacts related to old growth forests is found on page 4-67 of the Final PEIS and provides a summary of all impacts that could occur should geothermal development occur in old growth forests. In all cases, site-specific NEPA analysis would occur to assess the impacts of projects within old growth habitats. This would include compliance with the Endangered Species Act, the applicable regional forest plan, and all other laws, policies, and regulations that protect old growth habitats.

O-49-8

The existing case law regarding the Roadless Rule is inconsistent. On August 12, 2008, the Wyoming District Court found the 2001 Roadless Rule violated NEPA and the Wilderness Act (State of Wyoming v. US Department of Agriculture). The District Court ordered the 2001 Roadless rule "set aside" and "permanently enjoined." This order is subsequent to a 2006 California District Court ruling that set aside the 2005 State Petitions Rule and reinstated the 2001 Roadless Rule. The United States Justice Department, on behalf of the Department of Agriculture, has filed motions with both the Wyoming and California courts seeking adjustments of those courts' conflicting judicial orders. Neither the Wyoming nor California District Court rulings bar the Department of Agriculture from promulgating other roadless area regulations. To address this inconsistency, the PEIS includes the following Department of Agriculture Roadless Area Stipulation, "If future legislation or regulations change the roadless area designation, the restriction would be revised along with any appropriate environmental review." An appropriate NEPA review would be required prior to any changes to the Roadless Area Stipulation.

O-49-9

Thank you for your comment. The comment is noted.

O-49-10

While the document states that old growth forest could be removed as a result of geothermal development, the authorized officer always retains the discretion to reject geothermal lease applications or lease parcels prior to issuance or sale, respectively.

It is also important to note that lands allocated as open are subject to existing laws, regulations, and formal orders, which could prohibit some lands from leasing.

All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis. This document does predict a general level of anticipated future geothermal development in BLM areas that have geothermal potential, but it is not intended to provide full analysis of all phases of development. There are several subsequent stages of decision making necessary to approve geothermal resource development, each with its own environmental compliance requirements, including public involvement, as applicable. This document covers only the land use planning and lease issuance stages.

In regards to the USFWS 2008 recovery plan, it is not a regulatory document. It provides guidance about how recovery for the spotted owl can be achieved and provides methods to apply to FS and BLM forest management that will benefit northern spotted owl. Changes have been made to the document to clarify this.

O-49-11

Prior to leasing, the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states typically manage and have regulatory authority for water quality, water rights, and wildlife. Site-specific impacts on water resources, including groundwater, would be addressed as part of the environmental analysis for the permitting process. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis, including public involvement, as appropriate. Appropriate site-specific mitigation would be developed as necessary. As stated in Section 4-4, impacts of development, utilization, and reclamation of geothermal resources include the potential for groundwater contamination. Appendix D provides BMPs to address methods to minimize contaminations. Federal, state, and local regulations ensure that operators will conduct drilling in a prudent manner. Potential for contamination based on local soil types and groundwater conditions would be assessed prior to issuance of permits for development.

O-49-12

The purpose of the analysis in Volume II is to provide supplemental analysis to the PEIS for the site-specific pending lease applications. Until a lease is obtained, an applicant cannot conduct the necessary drilling and data collection for establishing a definitive plan of development. Project-specific NEPA review will be conducted before drilling and any subsequent development.

O-49-13

As noted above, this document does predict a general level of anticipated future geothermal development in BLM areas that have geothermal potential, but it is not intended to provide full analysis of all phases of development. There are several subsequent stages of decision making necessary to approve geothermal resource development, each with its own environmental compliance requirements, including public involvement, as applicable. This document covers only the land use planning and lease issuance stages.

O-49-14

The purpose of the analyses in Volume II is to provide supplemental analysis to the PEIS for the site-specific pending lease applications. The analyses in Volume II are not stand-alone NEPA reports. The RODs for the 19 pending leases are dependant on the ROD for the PEIS and will be signed separately. Therefore, a timing break between the signing of the RODs for the PEIS and the 19 pending leases is not necessary. All of the backlogged pending lease applications were discussed during the scoping process. The Notice of Intent advertised the fact that the PEIS was assessing the backlogged lease applications, and a list of the pending lease applications were made available during scoping. Additionally, separate notices were published to inform the public about the analysis of pending lease applications on FS lands (see Section 6.2.1).

O-49-15

The comment is noted.

All of the areas mentioned in the comment have been addressed. The Forest Supervisor has the discretion to remove these areas from the lease, to impose stipulations and BMPs on the lease, or to deny the lease to protect specific resources.

O-49-16

The comment is noted. These concerns have been addressed in the analysis.

O-49-17

Sections 16.1.2 and 16.3.2 thoroughly address the requirements of the ACS, including the requirement that no geothermal development occur in Riparian Reserves and the requirement for a Watershed Analysis for development in Key Watersheds. The Forest Supervisor will consider these requirements when issuing a decision notice with a FONSI to the BLM. Effects on the objectives cannot be assessed at this leasing phase of analysis, when concrete development plans are not available.

O-49-18

The document identifies LSRs and states clearly that they are protected under the NWFP. The authorized officer always retains the discretion to reject geothermal lease applications or lease parcels prior to issuance or sale, respectively.

No development would occur in LSRs if it does not comply with the objectives outlined in the regional forest plan. Site-specific NEPA would also be conducted prior to any ground-disturbing activities that would further analyze the project, the exact location of old growth habitats, and the impacts that would result from any proposed development.

O-49-19

Section 15.3.2 states: "Additional discussion of impacts on land use and dispersed recreation from geothermal plant development is provided in Section 4 of the PEIS, under *Land Use, Recreation, and Special Designations*." The Forest Supervisor would take these potential impacts into consideration when issuing a consent determination to the BLM.

O-49-20

Chapters 15 and 16 do not have specific project proposals or even locations to evaluate, so impacts can only be discussed at a general level. The Forest Supervisor will take potential impacts on resources into consideration when issuing a consent determination to the BLM and may impose stipulations or BMPs on the lease, remove areas from the lease, or deny the lease altogether.

O-49-21

No transmission line would be permitted until a specific project is proposed and a separate NEPA analysis is conducted. This separate analysis would consider transmission line impacts, if applicable. There is no specific project proposed at this time.

O-49-22

Text has been revised to address potential impacts from any future geothermal development to the drinking water aquifer. The analysis has addressed any specific wildlife habitat conservation areas that are protected, including LSRs, Riparian Reserves, and species-specific habitat areas.

O-49-23

The PEIS has been modified to include additional climate change discussion for affected resources. Please see the water, soil, vegetation, fish and wildlife, and other resource sections in the Final PEIS.

A general discussion of the issue of offsets of greenhouse gas emissions is presented in Section 4.8.

All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis. This document does predict a general level of anticipated future geothermal development in BLM areas that have geothermal potential, but it is not intended to provide full analysis of all phases of development. There are several subsequent stages of decision making necessary to approve geothermal resource development, each with its own environmental compliance requirements, including public involvement, as applicable. This document covers only the land use planning and lease issuance stages.

O-49-24

The authorized officer always retains the discretion to reject geothermal lease applications.

It is also important to note that lands allocated as open are subject to existing laws, regulations, and formal orders, which could prohibit some lands from leasing. For example, if the BLM or FS determines that subsequent exploration, development, or utilization of lands would likely result in a significant adverse effect on a significant thermal feature within a unit of the National Park System, the lease would not be issued pursuant to the Geothermal Steam Act Amendments of 1988 (30 USC Section 1026[c]). Additional text has been added to Chapter 2 to clarify this point.

O-49-25

Although the BLM expects to be able to rely upon this analysis, combined with DNA evaluations to document NEPA adequacy, to make lease issuance decisions in the near term the issuance of a lease does not give the lessee the right to proceed with exploration or development (i.e., any surface-disturbing activities beyond casual use) in the absence of further site-specific permits with associated environmental analysis. Once the plans are amended, the BLM can make decisions whether or not to issue geothermal leases in conformance with the amended land use plan on the basis of this PEIS. Following this amendment process, it is the intent of the BLM that, upon receipt of future nominations or applications for direct use, affected BLM offices would be able to conduct a DNA evaluation to make lease sale decisions without further plan amendments or NEPA analysis, unless special circumstances require additional environmental evaluation. The BLM and FS would conduct other environmental reviews to comply with other laws, including but not limited to the Endangered Species Act and National Historic Preservation Act, prior to issuing leases (see Section 2.2.2 Lease Stipulations, Best Management Practices, and Procedures).

As noted in the responses above, there are several subsequent stages of decision making necessary to approve geothermal resource development, each with its own environmental compliance requirements, including public involvement, as applicable. This document covers only the land use planning and lease issuance stages.

O-49-26

Discussion of impacts for old growth forests acknowledges the potential for irreversible impacts from future geothermal development activities. The PEIS states:

> Old growth forests, which may have never been physically disturbed by activities such as logging, typically contain centuries-old trees or other plants that cannot be reestablished and would be permanently lost.

O-49-27

This PEIS allocates areas as being available or closed to geothermal leasing. Stipulations have also been identified that would be applied to protect sensitive resources. Before issuing any leases, the BLM would conduct the necessary review to ensure that leasing would be compatible with the local land use plan and would comply with all applicable Federal, state, and local laws and regulations. As noted in Section 2.2.2, there are a variety of stipulations and BMPs that could be applied to protect sensitive issues and conditions.

geothermal_eis

From: Mary_Christensen@blm.gov [Mary_Christensen@blm.gov] **Sent:** Thu 9/18/2008 4:09 PM
To: geothermal_eis
Cc:
Subject: Mail forwarded from geothermal_eis@blm.gov
Attachments:

This message has been automatically forwarded from geothermal_eis@blm.gov.

"Ronald Barr" To
<ronaldcbarr@cox. <geothermal_EIS@blm.gov>
net> cc
<erthpower1@aol.com>
09/18/2008 05:13 bcc
PM
Subject
Geothermal EIS

EARTH POWER RESOURCES, INC.

2407 S. TROOST AVE.

TULSA, OK74114

TEL. 918-743-5593

FAX. 918-743-5595

RONALDCBARR@COX.NET

September 18, 2008

Department of Interior
Washington DC

Dear Mr/Ms:

The idea of the Programmatic Review is premature. Because of the change in the leasing rules promulgated by the Energy Policy Act of 2005, public lands can only be leased through competitive lease sales. The Nevada BLM has not set a date for a new sale following the sale in August 2008 due to lack of nominations for new sales. The results from the August sale were strong but it is important to realize the leases that were offered were on lands where much work had been done over the preceeding 20 years, mostly in the 1970s and early 1980s. Very few lands are available for future sales where similar work and results have been completed and obtained. New exploration is necessary for geothermal to grow but there is no incentive for private industry to explore. C-50-1

The entire leasing process must be revisited and returned to the type of Open Leasing similar to the non-competitive leasing program under which public lands were first offered in 1974. At that time there were monthly simultaneous filing periods whereby leases applications were filed during each month. On the first day of the next month the applications to were opened and those that were not overlapped were eligible for leasing. Applications that overlapped each other by less than 50% were issued by a coin toss for the overlapped lands. When applications overlapped greater than 50% the Director of the BLM would deem the area to be an "Area of Competitive Interest" and a sealed bid auction would be held with the high bidder awarded the lease. In each instance the leases were only issued pending an environmental review. C-50-2

The work done is valuable but the programmatic EIS should not be put in place. The reason is that lands that may be attractive could be located on lands excluded that could be developed with remedial actions or other safeguards. The limitations of available lands set out in the Programmatic Review are too restrictive. Major fields could be needlessly put off limits. C-50-3

In order to reach an output level where geothermal can replace the energy to replace 1 million barrels of oil per day, or comparable production of natural gas, 1 million acres per year must be leased in each of the next 10 years. The type of calculation for this level of issuing leases is contained in a paper presented at the Second United Nations Symposium of the Development and Use of Geothermal Resources May 20-29 1975, "Geothermal Exploration: Strategy and Budgeting" by Ronald C. Barr pp. 2269-2271. The more leases that can be issued sooner, the more quickly geothermal can be used thus replacing natural gas for power generation in meaningful quantities. C-50-3

I urge that the Programmatic EIS not be implemented while industry is allowed time to change the law to enable a new leasing program that will increase the availablity of public lands for exploration. The work done to date can be valuable in this regard.

Sincerely yours,

Ronald C. Barr, President

C-50-1

The comment is noted. The PEIS does not alter the competitive leasing process as defined under Section 222 of the Energy Policy Act of 2005.

C-50-2

The PEIS cannot alter the competitive leasing process as defined under Section 222 of the Energy Policy Act of 2005.

C-50-3

Constraints identified in this document would be applied as appropriate. Where the agency determines that particular stipulations may be inappropriate for a planning area, the procedure for waivers, exceptions, and modifications would be followed (Section 2.2.2 *Lease Stipulation, BMPS, Procedures*).

Lands outside of the planning areas geothermal potential area identified in this document would not be prohibited from leasing; leasing would continue under the existing system outlined in Alternative A (Section 2.31).

C-50-3

The purpose of this PEIS is to facilitate the leasing process. Amending land use plans to include geothermal leasing should allow leasing to occur in a more expedited fashion than under the existing system.

geothermal_eis

From:	Mary_Christensen@blm.gov [Mary_Christensen@blm.gov]	**Sent:**	Thu 9/18/2008 4:40 PM
To:	geothermal_eis		
Cc:			
Subject:	Mail forwarded from geothermal_eis@blm.gov		
Attachments:			

This message has been automatically forwarded from geothermal_eis@blm.gov.

CKEZAR34@aol.com
To
geothermal_EIS@blm.gov
09/18/2008 05:37 PM
cc
bcc
Subject
exception for research on geothermal

BLS needs to add that it is open to exceptions when it comes to geothermal research. Two research areas are deep drilling to capture ten time the power from one well -- see Iceland Research IDDP.
Secondly research needs to be accomplished to test the engineering of hydrogen capture from magma and water interaction -- see www.magma-power.com
The potential hydrogen capture is enormous for example one Icelandic well vents 320 tons per year without any deliberate penetration of the magma. That quantity will run 75 fuel cell cars every day for many generations.

I-51-1

Chuck Kezar
Professor LSC
Research Professor Geothermal

I-51-1

This comment is outside the scope of the PEIS.

Geothermal Programmatic EIS
COMMENT Re Medicine LAKE

TO WHOM IT MAY CONCERN
FROM THE BLM + FOREST SERVICE

IN THIS DAY OF GREEN and PREVENTING GLOBAL WARMING WHY WOULD TO OF THE AGENCY IN CHARGE OF MOST OF OUR PUBLIC LANDS WANT to give a PUBLIC COMPANY THE POWER TO DO WHAT THEY DAM WELL PLEASE ON PUBLIC LAND WITH A LISCENCE FROM YOUR ORGANIZATIONS. I-52-1

I THIS DAY OF CONSERVATION, and TRYING TO STOP GLOBAL WARMING and SAVE MANY PARTS OF OUR ENVIROMENT AND MANY OF THE SPECIES THAT ARE THREATEND BY. WHY WOULD WE WANT TO DESTROY HABIT, RECREATION AREA, WILDERNES etc TO SEACH FOR A RESOURCE THAT MAY OR MAY NOT BE IN THE GROUND IN NATURAL AMOUNTS. FOUR MILE HILL FOR EXAMPLE SHOULD BE AN EXAMPLE TO ALL. AFTER ALL THE RESOURCE WAS NOT HOT ENOUGH to RUN A GEOTHERMAL PLANT I-52-2

THAT would Produce Electrical Power WITHOUT ADDING Acids and OTHER ARTIFICAL Means for production. WHAT Happen WHEN ALL of THIS GARBAGE GETS IN THE AQUIFER AND Spread for miles and Destroys HABIT For Fish & Game etc.

I-52-1

CALPINE SAYS THE SYSTEM IS Closed WHICH IT MAY BE TO START OUT WITH BUT WHAT HAPPENS WHEN A CASING Breaks OR EARTH MOVEMENT CAUSES breakage and lets THIS GARBAGE INTO THE Ground WATER.

I-52-3

Please HAVE ENOUGH COURTESY TO THE ENVIROMENT and THE EARTH TO REQUIRE THAT EACH GEO THERMAL Lease Have AN Individual ENVIROMENTAL IMPACT REPORT. EACH Lease IS AN Individual CASE and Should Have Individual CONSIDERATION. You would NOT Build A House WITH OUT MAKING Sure THAT THE FOUNDATION IS ON SOLID Ground. You would NOT LET A Drug COMPANY Give

I-52-4

You Personal A Drug That They
Did NOT KNOW WHAT IT Did
To You Body. SO Why do IT To
The Body of Mother Earth

IT does NOT MAKE sense To
KILL The Host Because is PROFITABLE
IN Dollars For CAL Pine, BLM
& The forest service. WITHOUT
Being Sure What The End Result

Please Require individual
Environmental Impact Reports
ON ALL Geothermal Lease IN
The medicine Lake High Lands. I-52-5

MAKE DAM Shur What
You are doing For The Sake
Of Future Generations.

THANK YOU
Joe W Hoyle
Melissa A Hoyle
1939 PABLO VISTA
SAN PABLO, CA 94806

I-52-1

The comment is noted.

I-52-2

The comment is noted.

I-52-3

As stated in Section 4-4, impacts of development, utilization, and reclamation of geothermal resources include the potential for groundwater contamination. Appendix D provides BMPs to address methods to minimize contaminations. Federal, state, and local regulations ensure that operators will conduct drilling in a prudent manner. Potential for contamination based on local soil types and groundwater conditions would be assessed prior to issuance of permits for development.

I-52-4

The comment is noted.

I-52-5

There are several subsequent stages of decision making necessary to approve geothermal resource development, each with its own environmental compliance requirements, including public involvement, as applicable. This document covers only the land use planning and lease issuance stages.

As described in *Procedures Prior to Leasing* (Section 2.2.2), prior to inclusion of a lease in a competitive bidding process, the BLM or FS would review the lease area for sensitive resources and would provide the necessary stipulations to protect these resources.

geothermal_eis

From:	Mary_Christensen@blm.gov [Mary_Christensen@blm.gov]	**Sent:**	Fri 9/19/2008 5:28 AM
To:	geothermal_eis		
Cc:			
Subject:	Mail forwarded from geothermal_eis@blm.gov		
Attachments:			

This message has been automatically forwarded from geothermal_eis@blm.gov.

James Witcher <jimwitcher@zianet.com>
09/19/2008 06:24 AM

To <geothermal_eis@blm.gov>
cc
bcc
Subject PEIS error

On page C-4 of Appendix C in Preliminary List of ACEC status for Fluid Mineral Leasing, the District office for Las Cruces is misspelled. Also, an ACEC, Rincon, is noted as "closed" and "no surface occupancy." I suspect this is in error and the "closed and no surface occupancy" designations should be associated with the Organ/Franklin Mtns above Rincon in the table. This is a serious mistake as Rincon is one of the high quality geothermal prospects in the Rio Grande rift. The local BLM office, Las Cruces, should review this issue. The Federal sections around the Rincon area are covered with roads, a no longer used community dump, several communications towers, an aggregate pit or quarry, along with several abandoned manganese mines and prospects. I-53-1

James C. Witcher, Las Cruces, New Mexico

I-53-1

According to the BLM New Mexico State Office and the Las Cruces Field Office, Rincon ACEC is closed to geothermal resource development. The Organ/Franklin Mountains ACEC is also closed. This status is based on the most current RMP update (1991). This has been updated in the Final PEIS, and the Las Cruces spelling has been corrected.

September 19, 2008

Draft Geothermal Leasing PEIS
c/o EMPSi
182 Howard Street, Suite 110
San Francisco, CA 94105-1611

Attn: Jack Peterson
Title: National Project Manager

Subject: Ormat Nevada, Inc. comments on Draft Programmatic Environmental Impact Statement (PEIS) for Geothermal Leasing in the Western United States

Dear Mr. Peterson,

Ormat Nevada Inc. is pleased to respond to the Draft Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States. Our technical staff comprised of geothermal experts with many years of experience reviewed the document. Our comments are attached separately.

If you have any questions or need more information about our comments, please contact Charlene Wardlow at 775-336-0155.

Best Regards

Sincerely,

Daniel Fleischmann

Daniel Fleischmann
Project Initiation Manager
Ormat Nevada, Inc.

Ormat Nevada, Inc. official PEIS comments

Volume I: PROGRAMATIC ENVIRONMENTAL IMPACT STATEMENT

Executive Summary
Comment on ES.5 ALTERNATIVES (Page ES-5)
Comment: The Proposed Action, Alternative B, is recommended. Alternative C – Leasing lands near transmission lines, is unacceptable. Future transmission planning in the West will likely be guided, in part, by expanding access to renewable energy resources. The existing U.S. transmission infrastructure is subject to modernization to meet 21st Century energy needs. With State RPS policies and federal incentives towards renewable energy, transmission lines will likely be built near clusters of renewable energy resource areas. Thus, transmission will come to the resource. C-54-1

Comment on ES.6 REASONABLY FORESEEABLE DEVELOPMENT SCENARIO (Page ES-6) *Also mentioned on Table 2-6 on page 2-35
"Most of the development would likely occur in northern Nevada, California, and Idaho, with the least amount in Wyoming and Montana." & "While not evaluated in detail for large scale commercial electrical generation, Montana and Wyoming have potential for small scale direct use electrical generation." C-54-2

Comment: While it is true that we reasonably expect less development in Montana and Wyoming than in other Western States, there is potential for larger-scale generation in both states. We do not understand the extent of the resource in either state. Although development would take place outside of the restricted boundaries at and around Yellowstone National Park and the Island Park KGRA, the existence of these massive geothermal anomalies suggests that Montana and Wyoming should not be written off entirely. This is especially relevant in that hot water may be co-produced with oil and gas wells in the oil and gas producing regions of Montana and Wyoming that may be on federal lands. We suggest that you do not make the statement that Montana and Wyoming only have potential for small scale direct use electrical generation.

Comments on ES.7 Impact Analysis (Page ES-7)
"If geothermal leases were developed, the following general adverse impacts would be expected…" According to the PEIS, these include: C-54-4

"Short-term impact to ground water during drilling" & "Loss of other land uses, such as livestock grazing, on land occupied by geothermal facilities." C-54-3

Comment on ground water: Can you please explain why the above statement is made that there would be short term impacts to groundwater from drilling operations?

Comment on grazing: We have never heard of grazing as an issue for a geothermal project. There is no reason a project couldn't be designated grazing if this were the area's current use. C-54-4

Chapter 1. Purpose of and Need for Action;
Section 1.6. Areas with Geothermal Potential C-54-5

Comment on Figure 1-5, page 1-16
Comment: In Arizona, the San Francisco Volcanic Field northeast of Flagstaff is not in the study area, despite receiving funding from the US DOE Geothermal Technologies Program for geothermal study for electric generation. Northern Arizona has typically been disregarded as an area of geothermal potential, and was left off the study area in the PEIS despite Ormat's suggestion it be included. The legal tracts encompassing this area are in: T23N, R8E 5 (SE corner), 4, 3, 2, 1; 8, 9, 10, 11, 12 (NW corner); 17, 16, 15 (NNW corner) +T24 N, R8E, 26 (SE corner), 25 (SSE half), 33 (SE corner), 34 (SSE half), 35, 36; T24 N, R9E, 30, 31; T23N, R9E, 5 (NW corner). This is based on public information provided by Northern Arizona University.

Chapter 2. Proposed Action and Alternatives;
Section 2.2. Proposed Action

Comment on Section 2.2.1 Identify lands for leasing, page 2-7
Comment: The COSO geothermal field is a perfect example of military operations working together with a geothermal operation. Thus, why is it stated the military reservations would be closed to geothermal leasing? We believe the Department of Defense should be the agency to make decisions concerning leasing on military lands not the BLM or USFS. C-54-6

Comment on Section 2.2.1 Identify lands for leasing, Figure 2-5, page 2-11
Comment: We believe that the PEIS is incomplete without identifying, on a state by state level, and/or whether any major KGRAs on this map are closed to leasing by statute or otherwise as defined by this document. For example, in Volume III, Appendix F, you list hot and warm springs throughout the Western U.S., but make no mention of which are closed to leasing. Might it be possible to do so? The map labeled Figure 2-5 is confusing because it indicates significant land areas that are closed to leasing in several key areas. The map suggests that much of the federal land in the Imperial Valley may be off limits to leasing. The map also suggests that much of Cascade Range in Oregon may be off-limits to leasing. This sends a confusing signal given the significant potential for geothermal power development in that region. More specific maps would be beneficial. C-54-7

Comment on Section 2.2.2 No Surface Occupancy Lease Stipulations header, page 2-16
Comment: Given the high level Section 106 consultation initiated for the PEIS, how will the areas of important cultural and archaeological resources (bullet 3) be known prior to the BLM/USFS issuing of the leases? These areas are already mitigated during a project development scenario including avoidance as required by existing federal laws. C-54-8

Comment on Section 2.2.2 Other Lease Stipulations header, page 2-18
"Any leases that contain thermal features (e.g., springs or surface expressions) would have a stipulation requiring monitoring of the thermal features during any exploration, development, and production of the lease to ensure that there are no impacts to water quality or quantity." C-54-9

Comment: Sometimes water quality and quantity are subject to natural changes. This statement presumes that all changes would be caused by geothermal operations.

Comment on Section 2.2.3 – Amend Land-use plants, Page 2-26
"The land use plan does not assess the reasonably foreseeable development scenario for geothermal development, or the analysis requires updating." C-54-10

Comment: We understand that some land-use plans up for amendment may not include geothermal because they have not identified areas of high geothermal potential. However, in oil and gas producing areas such as the San Juan Basin in Southwest Colorado and Northeast New Mexico, the Uinta Basin in eastern Utah, and other oil and gas producing areas in the Western U.S. could have geothermal fluids co-produced with oil and gas wells on federal lands. In Utah for instance, over 2,700 drilling permits were issued 2004 and 2005 (with over 54% on federal lands). 2005 broke state records at the time for new permits with 1,628; almost double the amount of permits issued in 2003. With so many wells potentially being drilled in this region, there may be geothermal co-produced with oil and gas wells. We would hope that each individual well that is already permitted to produce oil and/or gas would not be subject to an EIS for geothermal fluids should they want to use this untapped free source of heat energy. Thus, we request that co-production and Enhanced or Engineered Geothermal Systems (EGS) be added to the PEIS so that it will also facilitate geothermal energy development at existing oil and gas operations in the Western United States. An EGS description should also be added as a potential operation at any geothermal resource that is leased given the interest in this technology the United States Government, particularly the Department of Energy.

Comment on Section 2.2.4 and, Table 2-4 Pending Lease Applications, page 2-27
Comment: This should be consistent with Chapter 10 of the PEIS that expands on why these leases need site-specific review to determine whether to lease or deny leasing. C-54-11

Chapter 2: Section 2.5. Reasonably Foreseeable Development Scenario
Comments on Section 2.5.1, RFDs for Electrical Generation (Indirect Use), pages 2-40, 2-41, 2-42, 2-43, 2-45, and 2-46
Comment – Page 2-40, Table 2-8: Drilling 6 temperature gradient wells - .05 to .15 acre/well. This is only a 46 x 46 feet to 80 x 80 feet for a well pad. It may be necessary to bring in a rig that would require a wellpad up to 150 x 150 feet. C-54-12

Comment – 2-42: "Most temperature gradient wells are drilled with a small rotary rig…similar to that used for drilling water wells, or a diamond-coring rig, similar to that used for geologic sampling in mineral exploration and civic works projects. Neither rig of this size requires construction of a well pad or earth moving equipment unless the site is sharply graded." This is inaccurate. It is usually necessary to grade and build a wellpad for the drilling of temperature gradient holes. Can you please explain if you have information and/or data that support the assumption given? C-54-13

Comment – 2-42: "Several temperature gradient wells are usually drilled to determine both the areal extent of the temperature anomaly and where the highest temperature gradient occurs. Each drill site could disturb approximately 0.10 acres." See comment for Table 2-8. C-54-14

Comment – 2-43: "Once exploration has confirmed a viable prospect for commercial development and necessary leases have been secured, the drilling of exploration wells to test the reservoir can proceed." Typically, the first step is leasing a prospective piece of land. Then surface exploration and temperature gradient drilling will commence. Additional leases may be secured for areas around the original leasehold if such testing indicates potential outside the existing leasehold. However, typically, a strong lease position must be secured before any major testing can begin. It is too expensive to perform exploration prior to a lease position today. C-54-15

Comment – 2-45: "a 50 MW (net) power plant could require up to 25 production wells and 10 injection wells" Typically a 50 MW (net) power plant may require between 12 to 15 production wells and 5 to 7 injection wells. Your estimates are quite high and give the indication of far more significant surface disturbance. C-54-16

Comment – 2-45: "A geothermal power plant is typically supported by pipeline systems in the plant's vicinity…Pipelines are usually 24 to 36 inches in diameter" They could be as small as 8 inches depending on the type of pipeline. C-54-17

Comment – 2-45: "In general, plants have about 1½ to even miles of pipes with a corridor width of about 25 feet." The word "even" does not make sense and only 1.5 miles of pipeline is a very small number. It would be a very small well field to only have 1.5 miles of pipeline. C-54-18

Comment – 2-46: "Electric transmission lines—Transmission lines may range in length from 5 miles to 50 miles with a corridor width of approximately 40 feet. Wooden poles would most likely support them, and one acre could be disturbed per mile of transmission line." A 40 foot corridor would disturb almost 5 acres of land, not one. A 230 kV transmission line would require a larger corridor than 40 feet although it could be built on an H-frame wood pole structure. C-54-19

Chapter 3. Affected Environment
Section 3.7. Water Resources and Quality

General Comment on Section 3.7
Comment: Groundwater resources have not historically been impacted by geothermal development. The agencies with oversight for geothermal drilling and well completion insure that the casing and cement design protect any groundwater aquifer. Surface water has been impacted temporarily by spills; however, these have not caused long term impacts nor have they caused cumulative impacts. It is presumptuous to assume that geothermal exploration or development will impact groundwater resources of any kind. C-54-20

Comment on Section 3.7, page 3-72
Comment: "Groundwater is the primary water resource that is potentially affected by geothermal exploration and development". It is misleading to suggest that groundwater is impacted by geothermal resources. Although a geothermal resource is similar to groundwater, it is not a drinking water source due to its chemistry and its temperature. C-54-21

Comment on Section 3.7, page 3-74
Comment: "Although the boundaries of groundwater and surface water resources do not always coincide, the discussion below is organized by surface water (hydrologic) regions." Based on geology and hydrology, geothermal reservoirs are separated from cold water ground water aquifers by barriers of rock, usually clay. C-54-22

Comment on Section 3.7, page 3-80
Comment: On the discussion of hot springs at the top of the page, it is assumed that hot springs are connected to drinking water aquifers. This is an incorrect statement as the temperature of the hot springs and the total dissolved solids and mineral content makes them non potable. C-54-23

Comment on Section 3.7, page 3-84
Comment: In the 2nd paragraph, this is the first time "geothermal reservoirs" are mentioned in this section. Although the write-up on hydrologic regions is interesting there needs to be a section explaining the relationship between hydrologic regions and geothermal reservoirs and why it is relevant to the leasing of BLM/USFS lands for geothermal energy. C-54-24

Chapter 3: Section 3.8 Air Quality and Climate
Comment on Section 3.8.1, page 3-96
Comment: The Clean Air Interstate Rule (CAIR), which was struck down by the U.S. Court of Appeals for the D.C. Circuit in July of 2008, applied to states that shared borders with urban areas that are in non-attainment for criteria pollutants regulated by the EPA pursuant the Clean Air Act. This applied to such interstate metropolitan areas such as Washington DC, Virginia, and Maryland, as well as New York, New Jersey, and Connecticut. It was not applied to the Western United States involved with the PEIS. C-54-25

Comment on Section 3.8.2, page 3-98
Comment: "Due to its minute emissions, an operating geothermal energy development would most likely be exempt from air toxics emissions regulations." Add – "depending on the types of technology and local attainment status". C-54-26

Chapter 3: Section 3.13. Livestock Grazing
Comment on Section 3.13, pages 3-160 to 3-162
Comment: Geothermal projects could be designed to minimize impacts to grazing by the routing and design of the pipeline systems. Projects have been designed and are operating that minimize any impact to animals that roam. Grazing should not be a deterrent to leasing for geothermal. C-54-27

Chapter 4. Environmental Consequences
Section 4.15. Tribal Interests and Traditional Cultural Resources

Comment on Section 14.15.2 – How were the potential effects of geothermal leasing on tribal interests and traditional cultural resources evaluated? Page 4-117
Comment: Why can't site specific Section 106 consultation be completed for the lease applications that were pending as of January 1, 2005? This would serve to expedite exploration and development supporting the United States' goal of energy independence. C-54-28

Page 4-118 – Bullets at the bottom of the section
Comment: Please identify the geothermal resource areas that are within the setting of a National Register-eligible site, including traditional cultural properties and areas with important cultural and archaeological resources including Native American sacred sites. C-54-29

Chapter 6. Consultation and Coordination
Section 6.6. Potential Adoption of the PEIS by Other Organizations

Comment on Table 6-1: Consultation Invitation Letter Mailing Address, Page 6-10
Comment: The Shasta Nation of Siskiyou County, California is missing from this list. C-54-30

VOLUME II: ANALYSIS FOR PENDING LEASE APPLICATIONS
12. EL CENTRO FIELD OFFICE LEASES
Section 12.1. Introduction

Comment on Section 12.1.2 page 12-2; State Implementation Plan for PM10 in the Imperial Valley, Executive Summary, Final (1993) C-54-31
"The pending lease application sites fall within the Salton Sea Air Basin, which is classified as a nonattainment area for inhalable particulate matter with a diameter less than 10 micrometers (PM10), based on Federal Clean Air Act standards."

Comment: The Salton Sea Air Basin is also in nonattainment for Ozone. It is suggested that the Imperial Valley Air Pollution Control District be contacted for more current information.

Comment on Section 12.1.2 page 12-2; Imperial County General Plan (2003) C-54-32
"Growth within Imperial County is directed by the Imperial County General Plan. Geothermal energy development is addressed in one of the Plan's nine elements, *Geothermal and Transmission Element*. Imperial County has no direct land-use jurisdiction over public lands; therefore, neither the General Plan nor the Imperial County zoning regulations are directly applicable to activities proposed on public lands."

Comment: The Geothermal and Transmission Element was updated October 17, 2006. Proposed leases CACA 046142 and 043965 are bounded to the north and south by private lands that would be under the jurisdiction of Imperial County. Thus, it is very likely a project would be developed that involved both the BLM and the County.

Section 12.3. Affected Environment and Environmental Consequences
Comment on 12.3.6 Water Resources – Page 12-20 – Mitigation C-54-33
Comment: As stated in the document, surface water from the Imperial Irrigation District is the primary source of water for this area. Groundwater is generally unusable. Requiring an assessment of a project's impacts should only be required if the project is going to use groundwater in a significant amount.

Comment on 12.3.7 Air Quality and Climate; Page 12-21 under Setting, 2nd paragraph. C-54-34
Comment: This conflicts with page 12-2 and the sentence doesn't make sense. Misspelling of "and" to "are?"

Section 12.4 References
Comment on Section 12.4 References – Page 12-50 C-54-35
Comment: The reference to the 2003 Imperial County General Plan needs to be updated with the October 17, 2006 update listed above.

VOLUME III: APPENDICES
Appendix D: Best Management Practices - Mitigation Measures

Comment on Appendix D: Land use, Recreation, and Special Designations, Page D-4 C-54-36
"An access road siting and management plan shall be prepared incorporating existing BLM standards regarding road design, construction, and maintenance such as those described in the BLM 9113 Manual and the *Surface Operating Standards for Oil and Gas Exploration and Development* (i.e., the Gold Book)."

Comment: Historically the "Gold Book" has not been applicable to geothermal operations. Is this a policy change by the BLM? If this is a change, the Categorical Exclusions authorized for the oil and gas should also be applicable to geothermal operations.

C-54-1

The commentor's support for Alternative B is noted.

C-54-2

RFDs have been added for Montana and Wyoming at levels of 20 MW by 2015 and 50 MW by 2025 for each state. No data were available for these states, but the parallel to Colorado was drawn due to the similarity in resource base across the Rocky Mountain Region.

C-54-3

Prior to leasing, the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states typically manage and have regulatory authority for water quality, water rights, and wildlife. Site-specific impacts on water resources, including groundwater, would be addressed as part of the environmental analysis for the permitting process. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis, including public involvement, as appropriate. The BLM and FS would work with interested and affected parties to identify and resolve resource conflicts. Appropriate site-specific mitigation would be developed, as necessary.

C-54-4

The resource uses compatible with geothermal use are likely to vary depending on site-specific conditions. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis, including public involvement, as appropriate. The BLM and FS would work with interested and affected parties to identify and resolve resource conflicts. Appropriate site-specific mitigation would be developed, as necessary.

C-54-5

As discussed in Section 1.6, Areas with Geothermal Potential, the geothermal potential area used to delineate the planning area for the PEIS was developed in a collaborative manner with Federal and state agencies, universities, industries, research organizations, and experts in the field based on areas with a reasonable likelihood for development activity in the near future.

C-54-6

The discretionary closure referred to states where military lands would be closed to leasing only "where geothermal development would conflict with the military mission." See Section 2.2.1 *Lands Identified for Leasing*.

C-54-7

As noted in Section 1.9.3 (*Scope of Geographic Information System Data and Graphics*), the best available data were used in preparing the PEIS. However, there are limitations with datasets. The figures are meant to be illustrative to provide context. All of the criteria for allocating lands as open or closed are provided textually in Chapter 2 and can be used for assessing site-specific areas.

C-54-8

As stated in the PEIS, Section 2.2.2 *Procedures Prior to Leasing*, the authorized officer for the BLM or FS will consult with Native American Tribal governments, Alaska Natives, and State Historic Preservation Officers. Through consultation, the agencies would identify tribal interests and traditional cultural resources or properties that may be affected by the federal leases and the potential for geothermal energy development and the presence of archaeological sites and historic properties per Section 106 of the National Historic Preservation Act.

C-54-9

The comment is noted.

C-54-10

The PEIS covers geothermal leasing. Issuance of a lease does not require the lease holder to specify what kind or size of plant would be developed at the lease site.

Lessees may propose any type of available technology. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis.

C-54-11

The information in these two areas of the document are consistent. Chapter 2 provides an overview, whereas Chapter 10 provides more depth.

C-54-12

Text was added to the footnote that this is a representative average across all exploratory well locations. In general, for exploratory drilling, a large well pad is not required.

C-54-13

The RFD estimate is a representative average across all exploratory well locations. In general, for exploratory drilling, a large well pad is not required.

C-54-14

The RFD estimate is a representative average across all exploratory well locations. In general, for exploratory drilling, a large well pad is not required.

C-54-15

The key point of this sentence is that drilling to produce geothermal fluids cannot occur until a lease is obtained.

C-54-16

The estimate of wells is based on a literature review and input from industry about plants throughout the Western US. The actual number of wells is dependent upon a variety of factors.

C-54-17

Text was added about the size being as small as eight inches.

C-54-18

“Even” was changed to “seven.”

C-54-19

One acre was changed to “about five acres.”

C-54-20

The PEIS discusses that modern drilling practices reduce the potential for these types of impacts. However, as with any complex activity and natural conditions, the potential for these impacts is always present. Due to the programmatic nature of this PEIS, addressing great variations in location, environment, technology, and methodologies is not possible. The RFD describes the range of potential impacts from future geothermal development.

C-54-21

The text in Section 3.7 has been clarified to read “Geothermal resources primarily involve the presence and characteristics of available heat and geothermal fluids (water, steam, or a mix). Groundwater is more likely than surface water to be potentially impacted by geothermal exploration and development.”

C-54-22

The section is discussing groundwater and surface water resources on a regional scale. The interrelation of groundwater within geothermal reservoirs and groundwater outside of geothermal reservoirs is more dependent on local conditions. Text has been added to Chapter 4 to discuss the hydrological connection, or lack thereof, of geothermal reservoirs to other groundwater sources. See response to comment 1-2-4.

C-54-23

The discussion of hot springs is meant to be independent of water quality. The organization of this section of the Draft PEIS was surface water, groundwater, groundwater quality, and then hot springs. This has been changed to surface water, hot springs, groundwater, then groundwater quality to avoid further confusion.

C-54-24

The section is discussing groundwater and surface water resources on a regional scale. The interrelation of groundwater within geothermal reservoirs and groundwater outside of geothermal reservoirs is more dependent on local conditions. Text has been added to Chapter 4 to discuss the hydrological connection, or lack thereof, of geothermal reservoirs to other groundwater sources. See response to comment 1-2-4.

C-54-25

The comment is noted, and references to the Clean Air Interstate Rule have been deleted.

C-54-26

The document was revised as recommended.

C-54-27

The resource uses compatible with geothermal use are likely to vary depending on site-specific conditions. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis, including public involvement, as appropriate. The BLM and FS would work with interested and affected parties to identify and resolve user conflicts. Appropriate site-specific mitigation would be developed, as necessary.

C-54-28

The BLM and FS are consulting with the tribes on the pending lease applications. Section 4.15.2 is focused on the programmatic level and acknowledges that consultation would have to occur once there are formal lease nominations in the future.

C-54-29

As stated in PEIS Section 2.2.2 *Procedures Prior to Leasing*, the authorized officer for the BLM or FS will consult with Native American Tribal governments, Alaska Natives, and State Historic Preservation Officers. Through consultation, the agencies would identify tribal interests and traditional cultural resources or properties that may be affected by the federal leases and potential geothermal energy development and the presence of archaeological sites and historic properties per Section 106 of the National Historic Preservation Act.

C-54-30

The Bureau of Indian Affairs provided the list of federally recognized tribes for consultation. The Shasta Nation of Siskiyou was not included in this list but has been added to the project mailing list. Prior to individual leases being included in a lease sale, coordination with local affected tribes would be initiated.

C-54-31

The comment is noted; however, per the title of the section being referred to, the State Implementation Plan is for PM10, not ozone.

C-54-32

The 2003 General Plan was used in preparation of the PEIS. The comment is noted regarding Imperial County's involvement.

C-54-33

Prior to leasing, the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states typically manage and have regulatory authority for water rights. Site-specific impacts on water resources, including groundwater, would be addressed as part of the environmental analysis for the permitting process.

C-54-34

The BLM presumes that the perceived conflict is that page 12-21 of the Draft PEIS says the air basin is nonattainment for both PM10 and ozone, whereas page 12-2 only mentions PM10. Page 12-2 does not mention ozone because the subsection is addressing the State Implementation Plan, which relates to PM10 but not ozone.

C-54-35

The 2003 General Plan was used in the preparation of the PEIS.

C-54-36

The “Gold Book” is a well known source for BLM road and construction standards that are directly applicable to the types of development that also occur for geothermal resource development. It is not a change in policy.

Medicine Lake Citizens for Quality Environment, Inc.
Save Medicine Lake Coalition
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September 19, 2008

Sent via e-mail and US Postal Service

Draft Geothermal Leasing PEIS
c/o EMPSi
182 Howard Street, Suite 110
San Francisco, CA 94105-1611

Re: Programmatic Draft EIS for Geothermal Leasing in the Western United States

Dear Sirs,

Thank you for the opportunity to comment on the Draft PEIS for geothermal leasing.

The Save Medicine Lake Coalition, which is comprised of the Medicine Lake Citizens for Quality Environment, the Klamath Forest Alliance and the Fall River Wild Trout Foundation, was organized over 10 years ago. We are a diverse group consisting of concerned property owners, environmentalists and recreation users including campers, hunters, fishermen, snow enthusiasts and everyday people who care about protecting the pristine qualities of the Medicine Lake Highlands from the long-term and significant impacts of geothermal industrial development. The natural forest surroundings of the Medicine Lake Highlands are located in the Modoc, Klamath and Shasta-Trinity National Forests in the Cascade Range of northeastern California.

First and foremost, the Medicine Lake Highlands (MLH) must be declared CLOSED to all geothermal leasing and the geothermal industry itself. The on-going controversy surrounding the proposed MLH geothermal projects will never go away if it is not closed. The Draft PEIS fails to mention the pending legal actions that are taking place there; including the federal lawsuits and the geothermal lease renewals that have been deemed invalid by the Ninth Circuit Court of Appeals. O-55-1

Our organization's initial response to the Draft PEIS is one of skepticism and concern in regards to the Bureau of Land Management and the US Forest Service's accelerated and vast approach to geothermal leasing on public lands. A staggering 77% of lands (192 million acres) under their jurisdiction, within the twelve contiguous western states and O-55-2

Alaska, could be impacted by the consequences of the programmatic decisions regarding geothermal leasing. The PEIS opens the door for maximum geothermal leasing and development of our forests and public lands. The existing rules and regulations in the agencies land use plans will be amended to fast track and support geothermal leasing.

We consider the geothermal leasing PEIS to be an enormous undertaking that merits thorough studies of the impacts to public lands and natural resources prior to issuing any leases.

In regards to the general level of environmental review in the Draft PEIS, the PEIS and amendments to the agencies land use plans should require site-specific environmental review prior to project approvals. The review process must include public notification, public comments and a requirement to address the full range of environmental and cumulative impacts. 0-55-3

……………………………………………………………………………………………..

The following comments are based on 10 years of first-hand experiences in dealing with geothermal leasing and the proposed geothermal developments in the pristine and sacred Medicine Lake Highlands. The Highlands are not being directly analyzed in this document, but the decisions and conclusions found in the PEIS may have a distinct and direct affect upon leasing in the Highlands. These comments are meant to be directed at the Draft PEIS through the use of geothermal examples and situations that have occurred in the Medicine Lake Highlands and which could happen anywhere in the vast scope of the PEIS western states leasing scenario. 0-55-4

Geothermal lease holders and developers <u>must not</u> be given *exclusive* rights to explore and develop all geothermal leases (PEIS 4.1.1, vol.1). The PEIS must give the federal agencies a clear and unrestricted right to deny a lease project without the threat of a "takings lawsuit" by the lease holder/developer.

The ***exclusive lease rights*** scenario played out in the Medicine Lake Highlands when the USFS and BLM initially denied the Telephone Flat Geothermal Development Project in a May 31, 2000 Record of Decision (ROD). Shortly after receiving the negative ROD, the developer threatened to sue the agencies via a $100 million dollar lease *takings* lawsuit, subsequently the agencies yielded to pressure and reversed the Record of Decision in favor of the leaseholder. Heated appeals and federal lawsuits still surround the controversial geothermal leases and the proposed geothermal projects in the sacred and pristine Medicine Lake Highlands.

Table 2-7, page 2-35:
The Table shows that the Medicine Lake/Glass Mountain area has a vast commercially viable RFD capacity of 480 mega-watts. Are the Table 2-7 figures based on past geothermal exploration activities and well venting from the 1980's or are the figures based on the more recent Fourmile Hill Geothermal Exploration Drilling Project's meager temperature gradient results at well pad 88-28? Either way, the projected 480MW 0-55-5

figure is exaggerated and misleading in regards to the likely MW capacity of the Highlands. **It is the developer's pipedream….*elevate the MW figures and the Medicine Lake Highlands will never be considered or closed to geothermal leasing or development.***

Unfortunately, Table 2-7 simply raises the red flag of skepticism regarding the accuracy of the leasing information and the MW calculations behind the RFD scenario in the programmatic document.

Table ES-1, page ES-4:
The table shows little difference in Alternatives B and C when it comes to leasing for Direct Uses. The environmental impacts of geothermal leasing/development for Direct Use will most likely be minimal and benign. But the impacts from leasing for the Indirect Use scenario will neither be minimal or benign. The Final PEIS needs to discuss the **West-side Energy Corridor PEIS,** mentioned on page 1-34, vol.1 1.14.3, and the impact it may have on the agencies selecting either Alternative B or Alternative C. 0-55-6

GROUND DISTURBANCE: Table 2-9, pg. 2-47 Cumulative range of Acre Disturbance for the RFD
The PEIS impact analysis mistakenly claims that the typical surface disturbance total for a geothermal generation project is between 53 to 367 acres. The proposed Medicine Lake Geothermal Projects, both the Fourmile Hill Project at 388.5 acres (Vol. 1, pg.2-12, Geothermal Development Project FEIS/EIR) and the Telephone Flat Project at 518 acres ((Telephone Flat FEIS/EIR, pg. ES-1, including 15 acres per transmission line mile, 23 miles) are actually much larger than their FEIS/EIR estimates. The Fourmile Hill 388.5 figure includes a 10 acre power plant site with 2.5 acre drill sites which were actually clear-cut and enlarged to over 20 + acres and 15+ acres each respectfully; see Exhibit 1 Fourmile Hill power plant site photos and Exhibit 2, Fourmile Hill drill site 85-33 photo. 0-55-7

Since the Medicine Lake Geothermal Projects are considered *typical* 48 to 49 MW power plants, the PEIS under-estimates the actual ground disturbance foot print that geothermal leasing, exploration and development will actually create. It is a huge miscalculation which will significantly affect more geothermal leasing acres. The geothermal surface disturbance calculations need to be readjusted and analyzed in the Final PEIS.

IMPACT ANALYSIS, page ES-7
The PEIS claims *to analyze a reasonably foreseeable development scenario to assess the likely impacts from subsequent development and the combined effects from leasing and development in the planning area.* The PEIS's impact analysis is a white wash that barely covers the significant and adverse environmental impacts that could occur via geothermal leasing. 0-55-8

NOISE IMPACTS:
The **PEIS pg. ES-7** erroneously claims that *geothermal operations would have minimal noise impacts.* Figure 3-23 Comparison of Sound Pressure Level and Sound Pressure, 0-55-9

pg.3-219, vol.1 and Table 3-42, pg.3-220, vol.1 should use geothermal drilling rig noises and power plant operational noises to make viable noise comparisons. The noise impacts at rural Medicine Lake would be constant and inconsistent with the peaceful sounds of the surrounding forests. Make-up wells would be drilled throughout the summer months when recreation activities flourish. The silence of the snowbound winters would be shattered by the endless 24-7 drone of the power plant turbines along with well venting and maintenance activities. Noisy wintertime sno-cats hauling men and equipment to and from the power plants would not only assault the auditory senses but would interrupt wildlife patterns as well.

RECREATION LOSSES:
The **PEIS pg. ES-7** claims that there would be *some loss of recreation opportunities from energy infrastructure although new roads could provide access for additional recreation opportunities.* At the Fourmile Hill Geothermal Project, the public was threatened with prosecution and jail time if caught trespassing on the Project roadways. The roads at *the Geysers* in Lake and Sonoma County, California are not open to the public. New roads associated with geothermal development will not likely provide for public access or enhance recreational opportunities. Hunting, hiking and site-seeing, that was once the norm on public lands will now be restricted by geothermal developments and by developers who consider public access *trespassing* as well as a safety liability. O-55-10

GROUND WATER IMPACTS:
The **PEIS pg. ES-7** claims *short-term impacts to ground water during drilling*. Geothermal drilling is the foundation of geothermal exploration and development. Drilling is the main component of geothermal development. As old wells peter-out, new make-up wells are drilled to maintain sufficient steam supplies to keep the power plant generating. Millions upon millions of gallons of ground water are needed for both drilling and power plant operations. Geothermal drilling and development demands in-depth analysis of water useage. O-55-11

PEIS pg. 4-40, Vol.1 quote, "Substantially depleted groundwater supplies or interfered substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level; "or "Resulted in uses or facilities that would substantially degrade surface or groundwater quality;" or "Resulted in changing conditions so that the geothermal resource itself was degraded."

PEIS pg. 4-43, Vol.1 quote, "There is a moderate risk for moderate to high impacts on groundwater supplies from the use of groundwater for geothermal activities."

PEIS pg.4-45, Vol.1 states, "withdrawing shallow groundwater or surface water for cooling purposes could affect nearby springs."

The only groundwater in the Medicine Lake Highlands is found in the Medicine Lake caldera. The caldera's shallow fresh water aquifer is also connected to the surface waters of Medicine Lake, Little Medicine Lake, Bullseye Lake, Blanche Lake and Paynes Springs.

All of the lakes and springs in the caldera, including the fresh water aquifer, are recharged by yearly snowfall. Because Medicine Lake and the freshwater aquifer are directly related, geothermal drilling and development will have a distinct and significant impact upon the groundwater and the water levels of the lakes and springs.

California's continuing drought has vastly affected the water level of Medicine Lake, dropping the lake level to near record lows. The drought has also affected water levels in the shallow groundwater aquifer, which in turn has adversely affected the local cabin owner's water well levels.

The proposed dual flash power plants for the Medicine Lake Highlands have a significant potential to deplete the groundwater as well as change the surface and spring waters throughout the caldera; in depth analysis and mitigation measures must focus on eliminating these impacts.

The Geysers have incorporated and now depend on nearby city sewage treatment plants to replenish their dwindling geothermal resources via waste water pipelines. The Medicine Lake Highlands does not have any large suburban populations to draw waste water from for steam resource regeneration. The closest water supply, beyond Medicine Lake, lies to the north in the Klamath Basin where a continuing battle over water rights issues is being waged by local farmers, the fishing industry and Native Americans.

To protect the West's vital watersheds, lakes, rivers and springs the PEIS needs to incorporate in-depth hydrological studies and analysis to fully determine the impacts of geothermal development upon those resources.

AIR EMISSION INCREASES:

The **PEIS pg. ES-7** makes vague claims that *the only time that air emissions will increase is during the drilling and construction phases of geothermal developments*. The PEIS fails to disclose that the projected 480MW power plant capacity of the Medicine Lake Highlands, translates into the construction of ten 48MW power plants in a 7 year span. And the PEIS also fails to mention that each power plant requires make-up wells be drilled to supply new steam resources to the power plants, usually on an annual basis. O-55-12

Ten power plants and numerous drilling rigs spewing toxin laced steam and polluting emissions into the Highlands, once pure atmosphere, could adversely affect the two Class 1 Air Sheds that are located in Lava Beds National Monument, 10 miles to the north.

Geothermal exploration activities, especially during drilling and well testing, regularly requires the venting of highly toxic emissions into the atmosphere which include geothermal gases, steams and brines which have been reported to cause adverse environmental and human health impacts. Construction expansions, periodic maintenance and facility upgrades of the power plants, pipelines and production/injection wells often result in toxic emissions and geothermal fluid releases into the surrounding environment, None of these impacts are analyzed in the PEIS.

CUMULATIVE IMPACTS:
PEIS pg ES-7-8 says that *degradation would occur but it would be relatively minor*. With the proposed fast-tracking PEIS leasing changes, by 2015, less than 7 years, the peaceful and pristine Medicine Lake Highlands recreation area could be transformed into an industrial wasteland by ten 49 MW geothermal power plants producing some 480MW. The degradation will hardly be minor; the cumulative impacts will be long-term, adverse and significant. Cattle won't even be safe grazing there (pg.ES-8). O-55-13

ENHANCED GEOTHERMAL SYSTEMS: (Pg.1-9, vol.1)
The use of Enhanced Geothermal Systems (EGS) should be prohibited until verified technology, research and development proves it to be a safe practice. Calpine Corporation has proposed using the highly controversial and experimental EGS acid process to stimulate the meager stream resource in the Medicine Lake Highlands. Calpine basically proposed to inject a 50,000 gallon cocktail containing extremely toxic hydrofluoric and hydrochloric acids into a production well, that hadn't been used in 20 years, in the hopes of stimulating the insufficient steam resource. O-55-14

The questionable EGS process may be an acceptable practice in 3rd world countries where environmental protection is not an issue, but not in the US, not in the Highlands and not in a 20 year old production well whose casing has been ravished by time and the elements. The direct risks and significant impacts of the EGS acid process are little known and the Medicine Lake Highlands and other sensitive environments should not be a testing ground for them.

EGS requires NEPA analysis and can not be tiered to this PEIS because its impacts have not been analyzed in this document.

SOCIOECONOMIC IMPACTS:
The socioeconomic impact is one-sided in favor of the geothermal industry. It does not analyze the cost to our public lands or the impacts it will have on established recreation areas. It doesn't mention rural communities or counties that depend on recreation income and how industry could effect change. The remote Medicine Lake recreation area has no services…no gas stations, no stores, no restaurants and neither telephone nor electric service. User's totally depends on the surrounding communities, located 25-50 miles away, to provide services. Recreation is the mainstay of Siskiyou and Modoc Counties, the remote Highlands recreation values are an asset to county coffers. O-55-15

Economic feasibility studies (un-biased) need to be analyzed in the Final PEIS.

WILDERNESS /ROADLESS AREAS:
The PEIS will be used to amend the agencies land use plans and it will be tiered to analyze specific projects. Wilderness and Roadless areas must be excluded from geothermal leasing and development. If not closed to leasing and development the Mount Hoffman Roadless Area in the Medicine Lake Highlands will be violated and dissected by the proposed and preferred geothermal transmission line corridor. O-55-16

RECLAMATION AND ABONDONMENT: PG. 4-6, VOL.1
All disturbed lands would be reclaimed in accordance with BLM and FS standards, and land uses and activities could resume. It's been over 20 years, many abandoned drill sites are scattered across the Medicine Lake Highlands, littering the forest landscapes with old well heads, oozing sumps and rusting debris, what standards actually exist for reclamation? Who is responsible or cares about enforcing agency standards? O-55-17

The Final PEIS needs to address financial bonding for reclamation that reflects prevailing expenses that adjust for inflation throughout a projects lifetime.

ALTERNATIVES:
The Draft PEIS really only gives us two alternatives, B&C. Alternative A is not an alternative, but simply a means to compare the action alternatives B&C. The Final PEIS needs to analyze a broader set of alternatives. There is a huge spread between A, *No Action* and B, *192 MILLION ACRES!* O-55-18

Alternative B should not be chosen because of the vast acreage that would be affected without adequate environmental review or protection for places such as the Medicine Lake Highlands or *other* special lands. O-55-19

Alternative C would be somewhat less harmful to the western environment than Alternative B, because fewer acres would be impacted by geothermal leasing and indirect geothermal development. Even though Alternative C limits leasing to a 20 mile corridor, 10 miles from centerline from existing transmission lines, it still does not protect *other* places and special lands from development. O-55-20

…………………………………………………………………………………………….

The Medicine Lake Highlands should never become a geothermal testing ground, sacrificed by new geothermal leasing rules and regulations that allow for controversial and experimental exploration and development practices; geothermal practices and projects that are driven by hefty state and federal subsidies; subsidies for a *questionable renewable energy* source that will <u>never</u> be *the silver bullet* for our country's seemingly insatiable energy appetite. O-55-21

The Medicine Lake Highland's remote and pristine forests and lakes should be preserved for generations to come. The Highlands are steeped in cultural history and abound with sacred sites that are honored by countless Native Americans. The Highlands vast recreational qualities draw thousands of visitors annually enjoying camping, hiking, picnicking, fishing, hunting, scenic vistas or observing the wildlife and botanical species which flourish there. The Medicine Lake Highlands must be closed to controversial geothermal leasing and development forever.

Thank you again for the opportunity to comment on this important PEIS leasing issue. Please keep our group on your information mailing list. We are incorporating by reference any and all comment made by the Mount Shasta Bioregional Ecology Center, the Pit River Tribe and the Stanford Environmental Law Clinic.

Sincerely,

Janie Painter

Janie Painter, chair
Medicine Lake Citizens for Quality Environment/Save Medicine Lake Coalition

Cc:
Debbie Sivas, Stanford Environmental Law Clinic
Kyle Haines, Klamath Forest Alliance
Mike Fitzwater, Fall River Wild Trout Foundation
Michelle Berditschevsky, Pit River Tribe
Peggy Risch, Mount Shasta Bioregional Ecology Center
Laurence Crabtree, USFS, Modoc National Forest
Tim Burke, BLM, Alturas Field Office

O-55-1

As described in Section 2.2.2 *Procedures Prior to Leasing*, prior to inclusion of a lease in a competitive bidding process, the BLM or FS would review the lease area for sensitive resources and would provide the necessary stipulations to protect these resources.

O-55-2

The comment is noted.

O-55-3

There are several subsequent stages of decision making necessary to approve geothermal resource development, each with its own environmental compliance requirements, including public involvement, as applicable. This document covers only the land use planning and lease issuance stages.

All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis.

O-55-4

The authorized officer always retains the discretion to reject geothermal lease applications or lease parcels prior to issuance or sale, respectively.

It is also important to note that lands allocated as open are subject to existing laws, regulations, and formal orders, which could prohibit some lands from leasing.

The text in Section 4.1.1 has been corrected. As noted in Section 1.11.1 *BLM Decisions to be Made Following Subsequent NEPA Analysis*, "…the issuance of a lease does not give the lessee the right to proceed with exploration or development (i.e., any surface-disturbing activities beyond casual use) in the absence of further site-specific permits with associated environmental analysis." As discussed in Section 1.5.1, geothermal leasing is guided by law (e.g., Geothermal Steam Act) and regulations, including the recently revised geothermal leasing and development regulations (43 CFR 3000, 32000, and 3280). The PEIS is not proposing to amend or change any of the laws or regulations.

O-55-5

As noted in the sources for Table 2-7, the RFD relied on the findings of research by the Department of Energy and a Western Governor's Task Force on geothermal resources, which included experts from government agencies, academia, industry, and research organizations.

O-55-6

Alternative C was analyzed based on existing transmission lines, not on those proposed in the West-Wide corridor EIS.

O-55-7

Disturbance footprints from any given geothermal development vary based on the technology, the location and distribution of the geothermal and hydrological resources, the climate, and many other factors. The RFD in the PEIS is based on a literature review and collaboration with geothermal development experts to contain an average expected range of disturbance.

O-55-8

The comment is noted.

O-55-9

Thank you for your comment. We have included a statement in the Executive Summary and in Chapter 4 to clarify potential changes to noise characteristics in remote areas.

O-55-10

The resource uses compatible with geothermal use are likely to vary depending on site-specific conditions. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis, including public involvement, as appropriate. The BLM and FS would work with interested and affected parties to identify and resolve user or resource conflicts. Appropriate site-specific mitigation would be developed, as necessary.

O-55-11

Prior to leasing, the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states typically manage and have regulatory authority for water quality, water rights, and wildlife. Site-specific impacts on water resources, including surface water, groundwater, and water importation, would be addressed as part of the environmental analysis for the permitting process. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis, including public involvement, as appropriate. The BLM and FS would work with interested and affected parties to identify and resolve user or resource conflicts. Appropriate site-specific mitigation would be developed, as necessary.

O-55-12

All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis. This document does predict a general level of anticipated future geothermal development in BLM areas that have geothermal potential, but it is not intended to provide full analysis of all phases of development. There are several subsequent stages of decision making necessary to approve geothermal resource development, each with its own environmental compliance requirements, including public involvement, as applicable. This document covers only the land use planning and lease issuance stages.

See Section 4.8.3 for the discussion of air quality impacts for all stages of leasing and development.

Although it is occasionally necessary to drill additional wells after a plant goes online, each well would be subject to additional environmental review and state air quality permitting requirements, including mitigation and monitoring, as appropriate.

O-55-13

As stated in the above responses, prior to inclusion of a lease in a competitive bidding process, the BLM or FS would review the lease area for sensitive resources and would provide the necessary stipulations to protect these resources.

O-55-14

The PEIS covers geothermal leasing. Issuance of a lease does not require the lease holder to specify what kind or size of plant would be developed on the lease site: therefore, discussion of alternate technologies is not appropriate in this analysis (see Section 1.11.1 *BLM and FS Decisions to be Made Following Subsequent NEPA Analysis* for further discussion of permitting). All development and utilization and reclamation activities would be subject to further site-specific permitting and environmental analysis.

O-55-15

Additional text has been added to the socioeconomics sections in Chapter 3 and Chapter 4 to address non-market values.

O-55-16

As discussed under Section 2.2.2, areas Congressionally designated as Wilderness Areas would likely be closed to leasing. Regarding roadless areas, the existing case law regarding the roadless rule is inconsistent. On August 12, 2008, the Wyoming District Court found the 2001 Roadless Rule violated NEPA and the Wilderness Act (*State of Wyoming v. US Department of Agriculture,* 07-CV-17-B, Wyoming District Court, Cheyenne, Wyoming [2008]). The District Court ordered the 2001 Roadless rule "set aside" and "permanently enjoined." This order is subsequent to a 2006 California District Court ruling that set aside the 2005 State Petitions Rule and reinstated the 2001 Roadless Rule. See *California ex re. Lockyer v. US Department of Agriculture*, 459 F.Supp.2d 874 (N.D. Cal 2006). The United States Justice Department, on behalf of the Department of Agriculture, has filed motions with both the Wyoming and California courts seeking adjustments of those courts' conflicting judicial orders. Neither the Wyoming nor California District Court rulings bar the Department of Agriculture from promulgating other roadless area regulations. To address this inconsistency, the PEIS includes the following Department of Agriculture Roadless Area Stipulation, "If future legislation or regulation change the roadless area designation, the restriction would be revised along with any appropriate environmental review." An appropriate NEPA review would be required prior to any changes to the Roadless Area Stipulation.

O-55-17

All reclamation activities would be subject to further site-specific permitting and environmental analysis. There are several subsequent stages of decision making necessary to approve geothermal resource development, each with its own environmental compliance requirements, including public involvement, as applicable. This document covers only the land use planning and lease issuance stages. BLM's new geothermal leasing regulations require bonding for exploration, building a well pad, drilling a well, and developing the resource. See 43 CFR subparts 3214 and 3215; 43 CFR 3251.14, 3261.18, and 3273.19. Under these regulations, bonds will not be released until BLM has determined that all wells are plugged and abandoned and the land is reclaimed.

O-55-18

In accordance with 40 CFR Section 1502.13, the purpose of and need for the proposed action is used to define a range of reasonable alternatives (purpose of and need for action is defined in Sections 1.2 and 1.3). The BLM is making an allocation decision here and adopting a list of stipulations, BMPs, and compliance procedures to be incorporated in the land use plans. The PEIS analyzes in detail the Proposed Action, a No Action alternative, and the Leasing Near Transmission lines alternative. The Final PEIS incorporates input from public comments on the Proposed Action. Another alternative considered but eliminated from detailed study included no leasing or development of geothermal resources on public or NFS lands (Section 2.4.1). As explained in Section 2.4.1, this alternative, which would have been the most protective (from a ground disturbance standpoint), was eliminated because it would violate the multiple use provisions of FLPMA and is inconsistent with the President's National Energy Policy, the Energy Policy Act of 2005, and Executive Order 13212 and would not have fulfilled the purpose and need for the proposed action.

The alternatives analyzed represent a range of acreages as potentially available for leasing. See CEQ's *Forty Most Asked Questions Concerning the CEQ's NEPA Regulations*, Question 1b ("When there are potentially a very large number of alternatives, only a reasonable number of examples, covering the full spectrum of alternatives, must be analyzed and compared in the EIS.") In particular, the Leasing Near Transmission Lines alternative was developed based on public scoping comments to represent a limited development alternative. Instead of inventing a variety of alternatives that would lie between the alternatives presented, the BLM and FS elected to include protective measures (i.e., stipulations, BMPs, and compliance procedures) in each of the action alternatives. Further, those planning areas whose plans include more protective measures may elect to keep those measures in place, instead of the stipulations, BMPs, and compliance procedures presented in the Final PEIS.

O-55-19

The commentor's concerns about Alternative B are noted.

O-55-20

The commentor's preference for Alternative C and concerns about Alternative C are noted.

O-55-21

As stated in the responses above, prior to inclusion of a lease in a competitive bidding process, the BLM or FS would review the lease area for sensitive resources and would provide the necessary stipulations to protect these resources. This review would include consultation with appropriate Native American Tribal Governments, as necessary.

STATE OF ALASKA

SARAH PALIN, GOVERNOR

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF OIL AND GAS

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September 19, 2008

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Re: Comments on BLM's Geothermal PEIS

Thank you for the opportunity to review and comment on BLM's Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States (PEIS).

Governor Sarah Palin has expressed a strong commitment to exploring and developing alternative forms of energy in the State of Alaska, including geothermal power. She supports BLM's efforts to make geothermal sites on federally owned land available for geothermal development in a timely and efficient manner.

A-56-1

We support the recommended alternative B described in the PEIS as it pertains to Alaska, which facilitates making the maximum land available for leasing outside of the areas that are closed to geothermal leasing by laws, regulations or Executive Orders. We anticipate cooperating with your agency to identify specific sites with geothermal potential in Alaska and encouraging their development.

In addition, we support alternative B for pending lease application sites AK 084543, 084544 and 084545, located on Bell Island in the Tongass National Forest, with appropriate stipulations and protections. A-56-2

We appreciate BLM's movement toward addressing the backlog of pending geothermal applications and the initiation of a PEIS that will facilitate prompt adjudication of future applications on federal land. A-56-3

The state has consistently held the position that all ANCSA (d)(1) withdrawals should be revoked because the purposes for which they were withdrawn have long been met. State participation in the BLM land use planning process for BLM lands within the geothermal planning area in Alaska will continue to push for the revocation of the withdrawals and opening to mineral entry, including geothermal exploration and development. A-56-4

Sincerely,

Kevin Banks
Acting Director

Post-it® Fax Note 7671	Date 9/19/08 # of pages ▸ 2
To Jack Peterson	From Kathy Means
Co./Dept. EMPSi	Co. AK-DNR-Oil & Gas
Phone #	Phone # 907-269-8757
Fax # 1-866-625-0707	Fax # 907-269-8943

A-56-1

The commentor's support for Alternative B is recognized.

A-56-2

The commentor's support for the pending lease applications on Bell Island is noted.

A-56-3

The commentor's support for the PEIS is noted.

A-56-4

The comment is noted. Under the PEIS, lands withdrawn under Section 17(d)1 are identified as closed to geothermal leasing under non-discretionary closure.

NPS Letterhead

September 19, 2008

L2360

To: Director, Bureau of Land Management
Attn: Jack G. Peterson

From: /s/Acting Director Dan Wenk

Subject: Comments on Draft Programmatic Environmental Impact Statement for Geothermal Leasing in Eleven Western United States and Alaska

The National Park Service (NPS) has reviewed the subject document and offers the following general and detailed comments for your consideration. Please note that our detailed comments are set forth in Attachment 1.

The Draft Programmatic Environmental Impact Statement (PEIS) for Geothermal Leasing in the Eleven Western United States and Alaska was prepared in keeping with the requirements of the Energy Policy Act of 2005, which calls for increasing the availability of geothermal energy sources through a competitive lease sale process. To meet these requirements, the Bureau of Land Management (BLM) and U.S. Forest Service (USFS) will be amending numerous land use planning documents to allow for increased geothermal leasing.

Under the Geothermal Steam Act Amendments of 1988 (30 U.S.C. §1026), Congress identifies sixteen units of the National Park System that contain significant thermal features (see Attachment 2). In order to protect these features, Congress directs that the Secretary of the Interior must "determine based on scientific evidence if exploration, development or utilization of the lands subject to the lease application is reasonably likely to result in a significant adverse effect on a significant thermal feature within a unit of the National Park System." If it will, the Secretary "shall not issue such lease." [30 U.S.C. §1026(c)]. In addition, the 1988 Amendments direct that stipulations be included in leases and drilling permits to protect the noted park units in the event that development is only "reasonable likely to adversely affect" the designated significant thermal features [30 U.S.C. §1026(d)]. A-57-1

While the Draft PEIS properly does not analyze leasing in any unit of the National Park System, the Final PEIS needs to analyze the potential impacts of leasing outside twelve park units that contain designated significant thermal features in the study area of the Draft PEIS. Because the Draft PEIS does not address this statutory requirement, it identifies areas as open to leasing with stipulations when many of these areas should be identified as closed to leasing. The Draft PEIS A-57-2
also does not adequately address the need for stipulations in leases and permits to protect the

twelve parks from adverse affects that are reasonably likely to occur. We ask that these two oversights be corrected before issuing the Final PEIS. The discussion in Attachment 1 under Crater Lake National Park illustrates the significant thermal features at risk, the state of the science, and why leasing adjacent to the park conflicts with the 1988 Amendments.

In addition to the special protection afforded certain park units under the 1988 Amendments, it is important to note that impacts to other park resources and values in all units of the National Park System located in the study area should be evaluated in the Final PEIS. The mission of the NPS is to protect units of the National Park System and to provide for their enjoyment in a manner that will leave them unimpaired for future generations. Because activities associated with geothermal development have the potential to adversely impact such areas, the BLM must take into consideration such impacts in light of the Secretary of the Interior's duties under the NPS Organic Act before issuing leases and approving site-specific projects. Among other things, the Organic Act directs that "[t]he authorization of activities shall be construed and the protection, management and administration of these areas shall be conducted in light of the high public value and integrity of the National Park System and shall not be exercised in derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress." (16 U.S.C. §1a-1)

The NPS also urges the BLM and USFS to include in the Final PEIS an evaluation of potential impacts to a variety of other special status areas for which the NPS has some programmatic responsibilities. Such areas include properties on the National Register of Historic Places, National Historic Landmarks, National Natural Landmarks, National Trails, National Wild and Scenic Rivers, and lands acquired under the Land and Water Conservation Fund Program and Federal Lands to Parks Program. A-57-3

To ensure that the congressionally designated significant geothermal features in park units are protected, and opportunities to mitigate impacts to thermal features in other park units and are factored into leasing decisions, we would like to arrange a meeting of experts from our bureaus along with experts at USGS. The meeting would be a means for identifying needed research, monitoring techniques and protection measures. We also think it would be advantageous for our two bureaus, along with USGS, to enter into a Memorandum of Agreement on how we will engage each other in carrying out the provisions of the 1988 Amendments. Kerry Moss of the NPS Geologic Resources Division will be contacting Bureau staff shortly. He can be reached at 303-969-2634 or by e-mail at kerry_moss@nps.gov. A-57-4

Attachments

ATTACHMENT 1

NPS Comments on Draft Programmatic Environmental Impact Statement for Geothermal Leasing in Eleven Western United States and Alaska

I. Overall Comments

NPS Units With Designated Significant Thermal Features

The Final DEIS needs to contain a table and a map that depict the location of designated significant thermal features in park units under the 1988 Amendments. As a sample, the table below lists six units of the National Park System in Alaska and their designated significant geothermal features. Most of these are volcanoes and associated features, which are being monitored by the USGS. At present, many of the potential geothermal lease areas indicated in the Draft PEIS overlap park units with designated significant thermal features which could lead prospective lessee to explore near lands administered by the NPS that should be off limits from exploration and leasing by statute.

A-57-5

GEOTHERMAL FEATURES IN UNITS OF THE NATIONAL PARK SYSTEM IN ALASKA

PARK	DGGS Site #	GEOTHERMAL FEATURE TYPE	LOCATION
ANIA	AA-34	Warm Mineral Springs, 23ºC	West of Surprise Lake in Aniakchak Caldera, 56º55’43”N by 158º06’00”W. Aniakchak Crater erupted in 1930s.
BELA	NC-3	Serpentine Hot Springs, 75ºC	Hot Springs Creek, 65º51’25”N by 164º42’33”W
GAAR	NC-15	Warm Springs,	Reed River warm springs (122ºF, 57ºC) @ 65º51’25”N by 164º42’33”W, Alatna River area warm springs @ 67º16”00N by 155º06’20”W, Lower Kugrak River warm springs @ 69º19”48”N by 144º02”38”W. (**Note:** these coordinates may not be correct.**)**
KATM	SC-3	Volcano, fumaroles @ 94 ºC	Mt. Martin @ 58 º10’N by 155 º21’W
	SC-4	Volcano, fumaroles	Mt. Mageik @ 58º 11’45” N by 155º 15’ 10”W
	SC-5	Volcano, fumaroles	Mt. Griggs @ 58º 21’15”N by 155º 05’ 30”W
	SC-6	Volcano, fumaroles	Mt. Katmai @ 58º 15’44”N by 154º 58’ 31”W
	SC-7	Volcano, fumaroles @ 29 ºC	Trident Volcano @ 58º 14’ N by 155º 05’ W
	SC-8	Volcano, fumaroles @ 89 ºC	Snowy Mtn @ 58º 27’24”N by 154º 20’ 56”W
	SC-9	Volcano, fumaroles	Kukak Volcano @ 58º 20’09”N by 154º 40’ 12”W
		Volcano, fumaroles	Four-peaked Mtn, recently reactivated
	SC-10	Volcano, fumaroles @ 93ºC	Mt. Douglas @ 58º 51’31”N by 153º 32’ 34”W
LACL	SC-12	Volcanoes	Mt. Iliamna, with steaming fumaroles, @

			.60º01'57"N by 53º05'24"W.
	SC-13		Mt. Redoubt, erupted in 1989/90 @ 60º29'15"N by 152º44'30"W.
WRST	SC-18	Volcano	Mt Wrangell, 86ºC fumaroles @ North Crater @ 61º59'34"N by 144º01'16"W.
	SC-19	Copper Glacier Warm Springs	20ºC @ 62º05'22"N by 143º48'22"W
	SC-17	Upper Klawasi mud volcanoes,	17 ºC on flanks of Mt. Drum @ 62º 04' 52"N by 145º 00' 17"W. (**Note** these features are entirely within Ahtna Native Regional Corporation lands with private lands between these features and the power grid near Glennallen, AK. NPS does not have jurisdiction over these lands and features.)
		Lower Klawasi mud volcanoes	20 ºC @ 62º 03' 27"N by 145º 13' 20"W

Data from oversized Map "Geothermal Resources of Alaska, 1983" by the Division of Geological and Geophysical Surveys, Alaska Department of Natural Resources, @ http://www.dggs.dnr.state.ak.us/webpubs/dggs/mp/oversized/mp008_sh001.PDF

Regarding the evaluation of subsistence uses for the Alaska leases, we note that the Draft PEIS at 1.13.16 identifies the requirement; however, evaluations for these leases are not included or otherwise referenced in the Draft PEIS. The usual practice in Alaska is to attach the ANILCA Section 810(a) subsistence evaluation as an Appendix. We recommend that the Final PEIS do this as well. A-57-6

Chapter 1

As previously mentioned, the Geothermal Steam Act at 30 U.S.C. §1026(c)(1) prohibits leasing of lands where the Secretary has determined that development is "reasonably likely to result in a significant adverse effect" on a statutorily designated significant thermal feature within 16 units of the National Park System. Twelve of the 16 units exist in the study area of the Draft PEIS. The Draft PEIS properly identifies this as one of the statutory prohibitions in Chapter 1.5.2, but there is no further description of how and when a determination will be made, what areas it may apply to, or how the NPS will be engaged in such determinations. This Congressional requirement establishes additional restrictions that need to be incorporated in the Final PEIS. There are many areas of BLM and USFS lands surrounding designated significant thermal features in park units where development may result in a significant adverse effect even with mitigation. These areas, by statute, must not be leased. In 1998, BLM revised its federal geothermal leasing regulations at 43 CFR Part 3200 to incorporate the statutory direction contained in the 1988 Amendments. A-57-7

Unfortunately, in most cases, insufficient studies have been conducted to date to aid in making the determination called for under the 1988 Amendments. In the face of this lack of data, it is important that the BLM exercise caution and err on the side of protecting the statutorily designated thermal features in the noted park units. A case in point is the inconclusive findings of a 1991 USGS study in which USGS evaluated the potential for geothermal development in the Corwin Springs, Montana area north of Yellowstone National Park impacting Mammoth Hot Springs located five to ten miles inside the park boundary (1991, Sorey, U.S. Geological Survey A-57-8

WRIR 91-4052). While this report concludes that larger scale developments could impact the Mammoth Hot Springs, it cites a lack of sufficient data with which to draw conclusions with more certainty. Given that all of Yellowstone National Park is designated as a significant thermal feature, this study points to the need for extreme caution in issuing leases outside this park. As a result, the Final PEIS needs to address this uncertainty at Yellowstone National Park and the other 11 park units.

For the Yellowstone Controlled Groundwater Area designation (1994, Water Rights Compact State of Montana and National Park Service, MCA 85-20-401), national, state and local geothermal and hydrogeological experts conducted a regional assessment. The experts were directed to delineate the area where there was any potential for water well development to affect the geothermal system within the boundary of the park. While this study is instructive, it is inconclusive with regard to the impacts that could emanate into Yellowstone National Park from geothermal development outside the park. It is important to note that the water well study did not consider release of pressure or cooling of rock via dry thermal system development, concerns that would be of issue in geothermal development. A-57-9

Chapter 2

The proposed action, as stated in Chapter 2.2, includes the identification of areas that are open to leasing with possible moderate to major constraints and areas that are closed to leasing. In Chapter 2.2.1., the Draft PEIS further describes non-discretionary closed areas to include lands within congressionally designated areas such as park units and wilderness areas. In Chapter 2.2.1., closed lands also include areas that could be closed based on BLM and USFS administrative discretion such as ACECs, NLCS, etc. Given the explicit language in the 1988 Amendments and BLM regulations, the Final PEIS needs to account for the non-discretionary closures required to protect the designated significant thermal features in park units. This area could be sizeable. As noted in our cover memorandum, the NPS will be following up with BLM and USGS experts to ensure that the special protection afforded park units under the 1988 Amendments are properly carried out. A-57-10

Chapter 4

It is important to recognize that significant thermal features are only the uppermost portions of one or more geothermal flow systems driven by heat sources at depth. A geothermal flow system includes hydrologic recharge, transmission, heating, and discharge components. To adequately assess impacts to significant thermal features, all potential changes to this entire geothermal flow system must be considered as well as the degree to which that feature relies on said system. The NPS has some experience with this issue. For example, the NPS and the State of Montana jointly pursued scientific evidence to address the potential for impacts to significant thermal features at Yellowstone National Park from groundwater development which, like geothermal development, includes drilling and fluid withdrawal. The result of that effort was a report by an independent working group of geophysicists, geologists, and hydrogeologists (Working Group) experienced in studying geothermal systems. The Working Group examined literature and data on development and associated observed changes for geothermal systems world-wide (1993, Recommended Boundary for the Controlled Groundwater Area in Montana A-57-11 near Yellowstone National Park, Custer, Michels, Sill, Sonderegger, Weight, Woesnsner). The Working Group reported that direct impacts were observed commonly more than a mile away and in some instances up to 22 miles away from development sites. It concluded that the full scope of impacts would logically be over a much greater area than the one to 22 mile range observed. While the extent of impacts reported is stated in general terms and based on very limited data, the report indicates that significant thermal features are susceptible impacts from development at great distances.

If the geothermal flow system is altered, some attributes will likely not be restorable. For example, if the pressure in the system is lowered, air or fluid passageways will collapse and flow will be closed off. Once these passageways collapse, it is likely that restoring pressure will not reopen the passageways.

The Draft PEIS states that no impacts on Congressional designations are anticipated from geothermal exploration and development at 4.2.7. The stated basis for this is that the congressionally designated areas will not be leased so there will be no exploration and development activities within the designated areas. This conclusion is not supported by scientific study or in keeping with the statutory direction contained in the 1988 Amendments. Furthermore, as noted above, exploration and development activities on land adjacent to or even miles away from the park units with Congressional designated thermal features could cause significant impacts to those features. This oversight needs to be corrected in the Final DEIS.

<u>Crater Lake National Park</u>

Crater Lake, our nation's deepest and clearest body of water, is vulnerable to impacts from geothermal development. The 1988 Amendments designate Crater Lake National Park as a unit of the National Park System that possesses significant thermal features. On the floor of Crater Lake, hydrothermal vents pump chemically rich water into the lake ecosystem. Not only are these geothermal features special natural resources in their own right, but research indicates that the features contribute significantly to the chemical balance and function of the Lake's complex ecosystem.

Subterranean and subaqueous geothermal resources by their nature are relatively little understood in terms of their extent, function and connectivity. Confounding this inherent uncertainty, the geothermal resources at Crater Lake are found at extreme depths of nearly 2000 feet below the lake surface. Consequently, research directed at understanding their extent and function and monitoring their condition is extremely difficult and costly. A-57-12

Based on the Draft PEIS maps of the potential areas for lease, U.S. Forest Service lands immediately adjacent to Crater Lake National Park appear would be open to lease even though scientific research does not support such a conclusion. Given the known significance of hydrothermal contributions to the integrity of the Crater Lake ecosystem as well as the unknown connectivity of these systems to areas beyond the park's boundary, the Final PEIS needs to ensure that the statutory duty to protect the vulnerable resources of Crater Lake is carried out. If scientific research does not indicate that stipulations will conclusively protect the surface and subterranean or sub aqueous geothermal features at Crater Lake National Park, then the area around the park may not be leased for geothermal development. This decision rule also applies with regard to the other park units with designated significant thermal features under the 1988 Amendments. New research and techniques may lead to a different conclusion in the future.

National Historic Trails and National Scenic Trails

We are pleased overall with the consideration given in the Draft PEIS to National Historic Trails and National Scenic Trails on public lands managed by the BLM and the USFS. The proposed closure of public lands to geothermal leasing within a one-mile radius from the centerline of trails recognizes the incompatibility of energy extraction with the recreational and educational use of trails. As the Draft PEIS appropriately notes, however, resources important to a National Historic or Scenic Trail often extend past a one-mile radius of the trail. We support the BLM and USFS proposal in the Draft PEIS to require further protection of the National Trails with sensitive viewsheds through lease stipulations. We also ask that protection also be afforded to the other special status areas for which the NPS has some programmatic responsibilities. Such areas include properties on the National Register of Historic Places, National Historic Landmarks, National Natural Landmarks, National Trails, National Wild and Scenic Rivers, and lands acquired under the Land and Water Conservation Fund Program and Federal Lands to Parks Program. A-57-13

Since site-specific details are not provided in the Draft PEIS, it is not clear to the NPS which segments of the Lewis and Clark National Historic Trail (Lewis and Clark Trail) are within the planning area and which segments are removed from potential leasing. It appears that the length of the Lewis and Clark Trail within the project and planning areas may not be accurate in the Draft PEIS. Due to the small scale of the maps that are provided in the Draft PEIS, we cannot fairly assess the accuracy of the Lewis and Clark Trail's location and length in the planning area. Better maps with more detailed geographical information would be helpful. NPS staff is available to help with this task. A-57-14

Impacts of transmission lines on the viewshed and other resources associated within the National Trails are not adequately discussed in the Draft PEIS. We found only one direct reference to this aspect of geothermal development in the Draft PEIS on page 4-127 which states, "Long-term impacts on national scenic and historic trails would result from construction of [electrical transmission lines] within the route or historic landscape of the affected trail." The Best Management Practices (BMPs) in Appendix D appear to apply only to the geothermal sites, and not to any related transmission lines. We recommend that the Final PEIS include an analysis of the potential effects of transmission lines associated with geothermal leasing as well as identification and discussion of BMPs for transmission lines. A-57-15

The Draft PEIS acknowledges that a wide range of impacts may occur to natural resources, many of which will be localized to the development site. Stipulations and BMPs are proposed to reduce the possible introduction of invasive species, protect critical habitat for threatened and endangered species, and protect wetland and aquatic resources. While thoughtful consideration of a wide range of concerns associated with extractive use of resources on public lands was presented in the Draft PEIS, we note that site-specific environmental analysis is required under the National Environmental Policy Act. Therefore, we ask that the NPS be specifically engaged in reviewing site-specific leasing areas before the BLM issue leases. A-57-16

II. Page-Specific Comments

Page 2-6, Section 2.2.1 – This section states that "[t]he BLM and FS have determined that certain lands within the planning area are excluded from geothermal leasing on the basis of existing laws, regulations (see 43 CFR §3201.11), and Executive Orders. These non-discretionary closures include the following lands:" This list should include the phrase "all units of the National Park System." A-57-17

Page 2-12, Figure 2-6 – In the Final PEIS, this map figure and other map figures elsewhere in the document need to clearly indicate the location of National Park System units and other federal areas closed to geothermal leasing within the geothermal potential areas, including areas around park units with designated significant thermal features. This would help prospective lessees to readily identify areas available for exploration and potential development. A-57-18

Page 2-47, Sec 2.5.1 – This paragraph states that "…production of geothermal fluids could be expected to vary widely from one to six million gallons per well, per day. Assuming five million gallons per day per well as an average production figure, a lease with two producing wells would produce 10 million gallons of fluid per day... In flash steam facilities about 15-20 percent of the fluid would be lost due to flashing to steam and evaporation through cooling towers and ponds." Assuming continuous pumping, five million gallons per day for each well equals about 3470 gallons per minute. A loss rate of 20 percent through flashing, evaporation, etc. will result in a depletion to the groundwater aquifer of about three acre-feet per day per well. The Final PEIS needs to indicated that an analysis is needed as to the implications that of a loss of three acre-feet per day will have on hydrologic resources on-site and on adjacent areas and whether water rights may be affected. A-57-19

Page 3-3, Section 3.2.1, 2nd to last sentence – Insert "USNPS" before USFWS. A-57-20

Page 4-4, Section 4.2.2, 2nd Bullet – We recommend inserting "(e.g., areas that could adversely affect designated significant thermal features in units of the National Park System.)" A-57-21

Page 4-5, Section 4.2.3 – The Draft PEIS states that "[a]ccording to the RFD scenario, it is estimated that 110 power plants could be constructed by 2015, and another 132 power plants could be constructed by 2025." This schedule would require the construction of more than one power plant per month. This scenario does not sound realistic and should be confirmed or revised in the Final PEIS. A-57-22

Page 4-18, Section 4.3.1 – The NPS believes similar comments could be made about protecting volcanic fumaroles and warm/hot springs in Alaska National Park System units as were made about the Yellowstone region. The Final PEIS needs to reflect a decision rule that areas around park units listed at 30 U.S.C. §1026(a) will not be available for lease until the proper studies have been conducted and needed mitigation identified to ensure the protection of the significant thermal features in those parks as required by law. A-57-23

Page 4-19, Section 4.3.3. Paragraph 1 – This paragraph and perhaps other sections in the Draft EIS refer to protecting geological features in national park and national monument areas. This A-57-24 language should be revised to replace “national park” with units of the National Park System. This change needs to be made throughout the Final PEIS. In addition, the Final PEIS needs to indicate that under the 1988 Amendments geothermal leases may only be issued adjacent to park units with designated significant thermal features if the Secretary of the Interior can determine based on scientific evidence that such development would not cause significant impacts to those features.

Page 5-18 (Sec 5.4) – This section states that “[t]he magnitude of actions on public and NFS [national forest service] lands considered in this analysis is great, information about how many future projects may actually be undertaken is lacking, and information about the likely locations of future development is unknown. As such, the cumulative effects discussed in this section are general in nature.” The NPS understands that this is a programmatic EIS; however, if large numbers of projects are contemplated using the Final PEIS, then some effort needs to be made to determine the cumulative effect of that large number of projects. This information is important in light of language included in the 1988 Amendments that requires the protection of designated significant thermal resources in parks units from federal geothermal leasing and site-specific development. A-57-25

A-57-1

The BLM and FS are committed to working with the NPS to avoid adverse impacts to thermal features within NPS units. The language in Section 1.5.4 *Environmental Review Requirements Prior to Leasing* has been revised to clarify further that the BLM is prohibited from geothermal leasing on NPS lands as well as on lands where the Secretary has determined that geothermal operations are reasonably likely to result in a "significant adverse effect on a significant thermal feature" in a unit of the NPS. In addition, a list of the 12 units of the NPS with significant thermal features that occur in the study areas is now included.

Prior to inclusion of any specific parcels in a lease sale, the BLM and FS would coordinate with the NPS to determine if there would be any impacts to thermal or hydrological features within NPS units in proximity to a proposed lease. Language has been added to Section 2.2.2 *Procedures Prior to Leasing* to reiterate this point.

In addition, should development be determined to be reasonably likely to have an "adverse effect" on a significant thermal feature, the BLM would include appropriate lease stipulations to protect the park unit.

If it is determined in advance of leasing that exploration, development, or utilization of the lease parcel would "reasonably likely result in a significant adverse effect on a significant thermal feature of a National Park System unit," then the lease would not be issued (30 USC Section 1026[c]). While preexisting leases and permits are beyond the scope of this PEIS, the statute also provides that if it is determined that use of an existing lease or permit would be "reasonably likely to adversely affect" any significant thermal feature within a National Park System unit, then stipulations are included on leases and permits to protect the thermal features (30 USC Section 1026 [c][d]).

A-57-2

As stated in the above responses, language has been added to the Final PEIS to specify that the BLM is prohibited from geothermal leasing on NPS lands as well as on lands where the Secretary has determined that geothermal operations are reasonably likely to result in a "significant adverse effect on a significant thermal feature" in a unit of the NPS.

A-57-3

As noted in Chapter 2, the Proposed Action affords protection to sensitive areas. For example, designated wild rivers are closed to leasing, while designated scenic and recreational rivers, and river segments determined to be potentially eligible for Wild and Scenic River status, would have a NSO stipulation. Likewise, National Register of Historic Places, National Landmarks, and National Register Districts would have an NSO stipulation (see Section 2.2.2 of the PEIS).

A-57-4

The BLM welcomes collaborative discussions.

A-57-5

The NPS lands have been added to the appropriate figures and noted as being closed to geothermal leasing. The listing of the NPS units with significant thermal features has been added to Chapter 1.

A-57-6

In Chapter 2, *Procedures Prior to Leasing*, the PEIS notes the following: "During the processing of any lease nomination or application in Alaska, the authorized officer of the BLM or FS would conduct a site-specific analysis of the effects of the lease on subsistence uses and needs in accordance with Section 810(a) of the ANILCA." At the programmatic level, it is uncertain what areas in Alaska would receive lease applications or nomination, so conducting a subsistence analysis in the PEIS would be too general for the intent of 810(a).

A-57-7

Language has been added to the document to further clarify that the PEIS is in accordance with the statutory direction in the 1988 amendments.

Please see response to comment A-57-1.

A-57-8

Please see response to comment A-51-1.

As stated above, additional language has been added to the PEIS to clarify that the BLM will avoid adverse impacts to thermal features within NPS units.

A-57-9

Given that impacts on geothermal resources from adjacent development may vary based on site-specific conditions, no specific buffer zone has been established for NPS lands.

A-57-10

Additional text has been added in Chapter 1 explaining the requirements of the Geothermal Steam Act Amendments. In Chapter 2 under *Procedures for Leasing*, additional text has been added clarifying that the BLM and FS will coordinate with the NPS and conduct the necessary review to make a determination of potential impacts to any significant thermal features in a NPS unit.

A-57-11

As stated in the above responses, language has been added to the PEIS to clarify that if it is determined in advance of leasing that exploration, development, or utilization of the lease parcel would "reasonably likely result in a significant adverse effect on a significant thermal feature of a National Park System unit," then the lease would not be issued (30 USC Section 1026[c]). In addition, if it is determined that use of an existing lease or permit would be "reasonably likely to adversely affect" any significant thermal feature within a National Park System unit, then stipulations are included on leases and permits to protect the thermal features (30 USC Section 1026 [c][d]).

A-57-12

Please see the above response.

A-57-13

As noted in Chapter 2, the Proposed Action affords protection to sensitive areas. For example, designated wild rivers are closed to leasing, while designated scenic and recreational rivers, and river segments determined to be potentially eligible for Wild and Scenic River status, would have a NSO stipulation. Likewise, National Register of Historic Places, National Landmarks, and National Register Districts would have an NSO stipulation (see Section 2.2.2 of the PEIS).

A-57-14

While attempts were made to accurately portray trail locations and alternate routes, the broad-scale figures provided in the PEIS are for illustrative purposes and should not be used to assess any site-specific actions or protections. The NPS should coordinate with those FS and BLM jurisdictions managing trail resources that would benefit from more detailed mapping and could contribute to assessments of trail locations and condition.

A-57-15

BMPs that discuss the impacts on trails have been checked and revised for consistency and to explicitly address the visual impacts of transmission lines.

A-57-16

Prior to inclusion of any specific parcels in a lease sale, the BLM and FS would review the lands for sensitive resources and would provide for the necessary stipulations to protect these resources. In addition, the authorized officer would coordinate with the National Park Service to determine if there would be any impacts to thermal or hydrological features within NPS units in proximity to a proposed lease. Language has been added to Section 2.2.2 *Procedures Prior to Leasing* to reiterate this point.

Furthermore, all development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis.

A-57-17

Suggested text has been added to document.

A-57-18

Figures in Chapter 2 have been revised to clearly indicate that NPS lands are closed to leasing.

A-57-19

The PEIS covers geothermal leasing. Issuance of a lease does not require the lease holder to specify what kind or size of plant would be developed on the lease site; therefore, discussion of alternate technologies is not appropriate in this analysis (see Section 1.11.1 *BLM and FS Decisions to be Made Following Subsequent NEPA Analysis* for further discussion of permitting). All development and utilization and reclamation activities would be subject to further site-specific permitting and environmental analysis.

Prior to leasing, the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states typically manage and have regulatory authority for water quality, water rights, and wildlife. A statement to this effect has been added to the *Procedures Prior to Leasing* section. Site-specific impacts on water resources, including groundwater and water importation, would be addressed as part of the environmental analysis for the permitting process.

As discussed in Section 1.5.1, water rights are administered and adjudicated at the state level. Each prospective lessee-developer will be required to apply for and obtain an adjudicated state water right before actually attempting to recover geothermal resources (see Section 1.5.1).

A-57-20

Language in the document has been revised, as requested.

A-57-21

Chapter 4-2 has separate analysis for land use, recreation and special designation areas. The following bullet in section 4.2.6 covers all special designation areas:

“result in proposed land uses that are incompatible with existing or adjacent special designation areas”

A-57-22

While perhaps optimistic, the projection is based on a collaborative effort, including the findings of a Western Governor’s task force consisting of industry, academic experts, and governmental agencies.

A-57-23

Additional language has been added to the PEIS to clearly identify the protective measures for thermal features on NPS lands. See response to comment A-57-1.

A-57-24

The suggested change has been made.

The suggested NPS language from the 1988 amendment has been added to Chapters 1 and 2 in the Final PEIS.

A-57-25

Additional discussion has been added to the cumulative impact analysis. As noted in Chapter 5, past, present, and reasonably foreseeable actions, including commercial uses of public and federal lands, are documented and analyzed.

THE WILDERNESS SOCIETY

September 19, 2008

Delivered via electronic mail (geothermal_EIS@blm.gov) and U.S. mail (with attachments)

Geothermal Programmatic EIS
c/o EMPSi
82 Howard Street, Suite 110
San Francisco, CA 94105

Re: Comments on the Draft Programmatic Environmental Impact Statement for Geothermal Energy Leasing

To Whom It May Concern:

Please accept and fully consider these scoping comments on behalf of The Wilderness Society and the other organizations identified below. The Wilderness Society's more than 300,000 members and supporters nationwide care deeply about the management of our public lands. Founded in 1935, our mission is to protect wilderness and inspire Americans to care for our wild places. We appreciate the opportunity to submit these comments to the Bureau of Land Management and Forest Service on the Programmatic Environmental Impact Statement (PEIS) for Geothermal Energy. We are submitting these comments today via electronic mail and also forwarding a copy with attachments to you separately.

We support development of clean, renewable energy resources because doing so promotes non-polluting, sustainable energy production that will benefit Americans and our public lands in the long term and encourages a move from a fossil fuels-based economy to a renewables-based economy. While we recognize geothermal energy can contribute to a clean energy economy and reduction of greenhouse gas emissions, like all energy production on public lands, geothermal resources must be developed responsibly and in a sustainable manner. This is of special importance in the western states which comprise the planning area, where water is a finite resource and becoming evermore so due to global warming. We must take precautions so that developing geothermal energy does not exacerbate the very problem that it has the potential to mitigate. If properly sited, geothermal energy can make a valuable contribution to our energy supply.

Geothermal energy development is an essential component of a renewable energy portfolio. As the PEIS states, there are potentially 12,000 MW of this resource in the planning area that are viable for commercial development by 2025. In Nevada alone, there are present-day requests of nearly 1,500 MW of geothermal energy seeking grid interconnection. Consequently, geothermal will play in increasingly important role in meeting both immediate and future western energy needs. As a renewable energy resource, geothermal energy stands alone as a "baseload" resource and has a very high (80% plus) "capacity factor" – meaning that commercial geothermal facilities produce power that can be consistently relied upon. Megawatt for megawatt, therefore, geothermal has the immediate capacity to replace energy coming from coal-fired power plants. Geothermal can also facilitate development of wind and solar resources, serving as a needed back-up or operating reserve to cover contingencies (i.e., when the wind is not blowing or the sun is not shining) and combining with these resources to use more transmission line capacity (wind and solar generally use only 50% or less of total transfer capacity), which ultimately lowers transmission costs for renewable energy.

In the spirit of assisting the agencies with responsible development of this important resource, we are raising two overarching concerns that are of particular relevance in this programmatic study, for which we also proposed detailed solutions. First and foremost, programmatic environmental studies serve the best opportunity to address suitability issues – i.e., given lands and hydrology impacts associated with known geothermal technologies and the many uncertainties with unknown and emerging technologies, not all western public lands are appropriate for this type of energy development. Valuable public lands, including roadless areas and proposed wilderness, must be closed to geothermal leasing and development. Second, a programmatic EIS is the perfect opportunity to develop a thoughtful and consistent approach to leasing and permitting. The Draft PEIS would open 117 million acres of public lands to competitive leasing all at once; this is not an acceptable approach. This vast amount of acreage suggests that a rigorous suitability analysis has not been performed in the current study. Rather, the agencies should develop a uniform process for prioritizing lease applications and site-specific permits for lands considered suitable for this type of energy production.

By preventing unnecessary impacts and facilitating development in the *right* places and in the *best* ways, such an approach should actually *speed* responsible development by avoiding unnecessary conflicts. Further, such an approach would ensure that geothermal development on public lands will truly achieve the goals set for using renewable energy to transition away from fossil fuels and combat the negative impacts of climate change.

These and other concerns are detailed in the comments below.

I. <u>Large-scale Geothermal Energy Leasing Requires Development of a Thoughtfully Designed Approach</u>

A. The risks and unknowns specific to geothermal energy development require caution before rushing into a large-scale program

O-58-1

According to the Energy Information Association, there are currently roughly 2,400 megawatts (MW) of installed geothermal electricity generation in the western United States, less than 1% of total U.S. generation capacity. The Reasonably Foreseeable Development Scenario (RFD) for the Draft PEIS forecasts that within the planning area, 12,100 MW of geothermal potential are considered viable for commercial electrical generation in 242 power plants by 2025; the RFD further estimates direct use applications of 4,200 thermal MW by 2025. Such massive development of geothermal resources will no doubt have significant impacts to the public lands and their many resources. We believe development predicted on this scale warrants careful studies of the impacts to public lands, water and other affected natural resources prior to issuing leases.

While significant development of flash steam power plants has allowed analysis of impacts from this indirect use of geothermal resources, most of the geothermal power plants planned for construction in the U.S. are binary-cycle. Though impacts from binary-cycle plants do not appear to be radically different from flash steam plants, additional technologies are being developed that will require much greater analysis before their impacts can be understood. In particular, “co-produced geothermal fluids,” also known as “produced water cut”, and “enhanced geothermal systems” are emerging technologies whose impacts are relatively unknown. Development of these resources should not be done without close examination of potential risks and impacts, and if development does occur it should be done slowly, in a phased manner, to ensure ongoing study can identify and fix problems and issues which arise.

For new technologies such as enhanced geothermal systems, a cautious approach emphasizing monitoring and strategic development is critical. Though the Draft PEIS states that “It is anticipated that there may be applications for research and development drilling on public and NFS lands in the future. While it is a viable and proven technology, it is unlikely that it will be applied at a large scale in the western US within the next 20 years.” Draft PEIS 1-9. The technological options have not been thoroughly tested in the US and requires further investigation to ensure that unacceptable impacts are avoided.

While Chapter 4 of the Draft PEIS examines the general types of impacts expected from geothermal development, the inability to predict future development scenarios, including types of development, timing and location will require additional site-specific analysis for individual leases and project applications.

Recommendations: Due to the projected scale of geothermal development and relative lack of knowledge of the impacts of such development, the agencies should approach geothermal development on public lands in a measured manner, using strategic development and monitoring, to ensure all impacts are minimized and mitigated and unacceptable impacts are avoided altogether. By “strategic” we mean that the locations with the highest potential resources coupled with the fewest environmental impacts are given priority, so that we encourage production while avoiding the most sensitive lands. In the case of new and developing technologies, research and development should be undertaken with caution and large-scale deployment of new technologies should only be done after sufficient analysis has been completed. Site-specific analysis of leases and project applications will also be necessary to address the particular impacts of future leases and projects. Overall, in addressing potential impacts to natural resources, the agencies should apply the “mitigation hierarchy” recommended by the Council on Environmental Quality of (1) avoid; (2) minimize; (3) reclaim/restore; (4) restore.

B. Geothermal development is not always renewable: water use of certain geothermal development systems demands in-depth analysis. O-58-2

Renewable energy resources are naturally replenishable, but flow-limited. They are virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time. Some (such as geothermal and biomass) may be stock-limited in that stocks are depleted by use, but on a time scale of decades, or perhaps centuries, they can probably be replenished. Renewable energy resources include: biomass, hydro, geothermal, solar and wind. (Source: http://www.websters-online-dictionary.org/RE/RENEWABLE_RESOURCES.html)

Because of water use, certain types of geothermal development are not "renewable" in the way that other renewable energy sources are. The Draft PEIS acknowledges that for flash steam facilities, "about 15-20 percent of the fluid would be lost due to flashing to steam and evaporation through cooling towers and ponds." Draft PEIS, p. 2-47. The Draft PEIS further addresses these impacts in Chapter 4, stating that potential impacts on water resources could occur if reasonably foreseeable actions were to result in "Substantially depleted groundwater supplies or interfered substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level;" or "Resulted in changing conditions so that the geothermal resource itself was degraded." Draft PEIS, p. 4-40. During drilling operations,

> **Extracting geothermal fluids could result in drawdowns in connected shallower groundwater aquifers, with the resulting potential to affect streams or springs that are connected to the water table aquifer**. The potential for these types of adverse impacts is reduced through extensive aquifer testing, which is the basis for designing the geothermal plant and for locating, designing, and operating the extraction and injection wells. Combined with the requirement to comply with state and federal regulations that protect water quality and with limitations imposed by water rights issued by the state engineer, the impacts on water quality and the potential for depleting water resources is expected to be minimized. **There is a medium risk for moderate to high impacts on groundwater supplies from the use of groundwater for geothermal activities**. Draft PEIS, p. 4-43 (emphasis added).

During utilization,

> Geothermal resource utilization could affect groundwater resources because of consumption of water by evaporation and the need to reinject water to replenish the geothermal reservoir. The magnitude of the effects would vary depending on groundwater conditions and availability within the basin and on the type of geothermal plant. Availability of water resources could be a limiting factor, affecting the expansion of geothermal resource development in a given area. Draft PEIS, p. 4-44.

The Draft PEIS further states that, "withdrawing shallow groundwater or surface water for cooling purposes could affect nearby springs." Draft PEIS, p.4-45.

Clearly, flash cycle plants have significant potential for depleting the water which is a critical component of the geothermal resource, limiting the "renewable" nature of this development. Further, all geothermal development has the potential for impacts to surface and groundwater quality and quantity, and analysis and mitigation must focus on limiting these impacts.

Recommendation: Because geothermal development can result in depletion of geothermal resources and water, if development conflicts occur between geothermal and wind or solar facilities, the impacts to water should be an important consideration in determining the best use of an area, as well as surface disturbance, so that renewable energy development with the lease impacts to resources that are present is given priority. The BLM and Forest Service should also prioritize binary cycle geothermal development over flash steam development to reduce the risk of depleting geothermal resources. The PEIS should specifically require additional site-specific analysis of potential impacts to geothermal and water resources of individual lease and project proposals.

C. Geothermal leasing and development should not be implemented in the same way as oil and gas leasing and development

O-58-3

The Draft PEIS repeatedly mentions the perceived similarities between oil and gas drilling and geothermal development and the intent of the agencies to rely on their experience with oil and gas development for fashioning their approach to managing geothermal energy development. The Draft PEIS states:

> BLM and FS have had a great deal more experience managing lands for development of oil and gas resources, and many more management plans address these resources. Development of oil and gas resources result in many of the same kinds of impacts as development of geothermal resources (e.g., surface disturbance resulting from the footprints of facilities, wells, pads and pipelines, as described in Section 2.5, Reasonably Foreseeable Development Scenario); therefore, BLM and FS have determined that it is appropriate to take an approach to development of geothermal resources similar to that taken to development of oil and gas resources. Areas that require protection from the effects of development of fluid resources are more likely to require protection from the similar effects of development of geothermal resources. Draft PEIS, p. 2-6.

In fact, for Areas of Critical Environmental Concern (ACECs), the agencies simply defer to the management approach for oil and gas development (Draft PEIS, p. 2-7), even though specific resources protected in individual ACECs vary widely and, as a result, the impacts of geothermal development on those resources will also vary. Analysis and management decisions specific to geothermal development are necessary.

Although similarities exist in the development and impacts of developing geothermal energy and oil and gas, there are also fundamental differences and opportunities. As discussed above and throughout these comments, the technologies used and still in development for geothermal energy often require significant amounts of water and can have different effects than oil and gas drilling. Also, while development of these energy sources can cause significant damage to other resources, such as wilderness qualities, wildlife, water, vegetation, and recreation opportunities, the agencies have already made major commitments to oil and gas leasing, and seen the devastating results to the public lands. The BLM and Forest Service should take the opportunity offered by this programmatic document to avoid the mistakes of the oil and gas program. Significant problems have beset the oil and gas program, including: inappropriate prioritization of leasing and drilling over all other resources and values; lack of adequate impacts analysis; failure to use the best available scientific research to inform management; insufficient monitoring and mitigation of impacts; inadequate leasing stipulations and Best Management Practices (BMPs) to protect other resources; abuse of exceptions and waivers from stipulations and BMPs; failure to employ true phased development; and inadequate bonding and reclamation. The failure to carefully plan, consider impacts and avoid damage to other resources and users of the public lands has resulted in serious conflict and devastating impacts to the public lands, as well as negative impacts to our economy and public health.

Geothermal development offers the opportunity to increase our national energy supplies while limiting greenhouse gas emissions and subsequent impacts from climate change. However, if the agencies do not learn from and avoid a repeat of the mistakes of the oil and gas program, any potential benefits could be outweighed by the recurrence of the problems listed above. BLM should instead adopt a measured approach that maximizes the benefits of geothermal development while limiting impacts to other resources and values. This PEIS provides an important opportunity to design a thoughtful approach to geothermal leasing and development.

Recommendation: BLM should adopt a measured approach to geothermal development, taking into consideration the unique aspects of geothermal development and avoiding the problems of the oil and gas program in order to maximize the benefits of geothermal development while limiting impacts to other resources and values.

D. Analysis and management of geothermal development should be conducted to achieve a net decrease in greenhouse gas emissions and related impacts that contribute to climate change. O-58-4

The development of renewable energy sources, including geothermal, offers the opportunity to limit damaging impacts from climate change by displacing electricity production from fossil fuels and thus reducing greenhouse gas emissions. As stated in the Draft PEIS:

> "A study comparing greenhouse gas emissions from electrical generation using fossil fuels and geothermal fluids found that geothermal produces an order of magnitude less in carbon dioxide, hydrogen sulfide, methane, and ammonia (Bloomfield *et al.* 2003)." Draft PEIS, p. 1-20.
>
> "Direct use of geothermal resources, such as using geothermal to heat buildings, has the potential to displace 18 million barrels of oil per year (WGA 2006). Increased geothermal energy utilization could help the US reduce greenhouse gas emissions and meet policy goals (Bloomfield *et al.* 2003)." Draft PEIS, p. 1-20.

We support the BLM's recognition of the importance of analyzing the effects of its action on climate change. Global climate change is now acknowledged to be a major consideration for effects of major federal actions. The Supreme Court has concluded that "[t]he harms associated with climate change are serious and well recognized." *Massachusetts v. E.P.A.*, 127 S.Ct. 1438, 1455 (2007). Further, the Supreme Court has held that while agency action may not completely reverse the effects of climate change, it does not relieve the agencies of the responsibility to take action to reduce it. Id. at 1458. In fact, an order issued by the Secretary of the Interior requires that:

> Each bureau and office of the Department will consider and analyze potential climate change impacts when undertaking long-range planning exercises, when setting priorities for scientific research and investigations, when developing multi-year management plans, and/or when making major decisions regarding the potential utilization of resources under the Department's purview.

U.S. Dept. of the Int., Sec. Order No. 3226 (Jan. 19, 2001), Section 3.

While there are many anticipated benefits to geothermal energy production over fossil fuels, in order to maximize these benefits, the PEIS must also address the potential for geothermal energy development to have adverse impacts on climate change or to increase negative impacts to resources that are affected by climate change. For example, many western landscapes are already becoming increasingly fragile due to global climate change and development of geothermal energy could inflict further damage on undeveloped lands. These landscapes may very well have important value as carbon "sinks," which could be lost if they are developed.[1] Further, undeveloped land has value as potential habitat as wildlife migrates to respond to climate changes. Damage to these lands for geothermal energy production, although more limited than other forms of energy development, could thus contribute to the negative impacts of climate change. Moreover, when analyzing individual projects, the net benefit for reducing the impacts of climate change may be affected by such factors as the location of the project in relation to workforce, due to the combustion engines used in construction and operation by personnel.

Though the Draft PEIS does address impacts to air quality and climate from geothermal development, it does so only in the context of comparisons between geothermal development and fossil fuels development. The PEIS should further analyze negative impacts to climate change from geothermal development on lands that are undeveloped and have values as carbon "sinks" and/or potential habitat. The PEIS should also seek to avoid or mitigate negative impacts on climate change from geothermal development by designating only appropriate lands for geothermal energy development and incorporating lease stipulations and BMPs to protect these lands.

Recommendations: The agencies should manage geothermal development on the public lands in a manner that will result in a net benefit for reducing the impacts of climate change and maximize these benefits. The PEIS should analyze climate impacts of geothermal development in the context of both the negative impacts to carbon-sinks and wildlife habitat and migration corridors, as well as the positive impacts in displacing fossil fuels electricity production.

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[1] *See, e.g., Have Desert Researchers Discovered a Hidden Loop in the Carbon Cycle?,* Science, Vol. 320, pp. 1094-140 (June 13, 2008) (attached).

Further, the PEIS should require similar analyses of proposed leasing and projects at a site-specific level, taking into account need for water, use of geothermal resources, and impacts from traffic to and from the site. Fully considering the net benefits from geothermal development will enable the agencies to best manage development of energy on the public lands and national forests to maximize the potential to reduce contributions to global warming.

II. <u>The Proposed Action Is Not Sufficient to Protect the Resources which the Agencies Are Charged with Managing.</u>

O-58-5

A. The agencies must consider a more protective range of alternatives.

NEPA mandates consideration of a full range of alternatives. The range of alternatives is "the heart of the environmental impact statement." 40 C.F.R. § 1502.14. NEPA requires BLM to "rigorously explore and objectively evaluate" a range of alternatives to proposed federal actions. *See* 40 C.F.R. §§ 1502.14(a), 1508.25(c).

> NEPA's requirement that alternatives be studied, developed, and described both guides the substance of environmental decision-making and provides evidence that the mandated decision-making process has actually taken place. Informed and meaningful consideration of alternatives -- including the no action alternative -- is thus an integral part of the statutory scheme.

Bob Marshall Alliance v. Hodel, 852 F.2d 1223, 1228 (9th Cir. 1988), cert. denied, 489 U.S. 1066 (1989) (citations and emphasis omitted).

"An agency must look at every reasonable alternative, with the range dictated by the nature and scope of the proposed action." *Nw. Envtl. Defense Center v. Bonneville Power Admin.*, 117 F.3d 1520, 1538 (9th Cir. 1997). An agency violates NEPA by failing to "rigorously explore and objectively evaluate all reasonable alternatives" to the proposed action. *City of Tenakee Springs v. Clough*, 915 F.2d 1308, 1310 (9th Cir. 1990) (quoting 40 C.F.R. § 1502.14). This evaluation extends to considering more environmentally protective alternatives and mitigation measures. *See, e.g., Kootenai Tribe of Idaho v. Veneman*, 313 F.3d 1094,1122–23 (9th Cir. 2002) (and cases cited therein).

NEPA requires that an actual "range" of alternatives is considered, such that the Act will "preclude agencies from defining the objectives of their actions in terms so unreasonably narrow that they can be accomplished by only one alternative (i.e. the applicant's proposed project)." *Col. Envtl. Coal. v. Dombeck*, 185 F.3d 1162, 1174 (10th Cir. 1999), citing Simmons v. U.S. Corps of Engineers, 120 F.3d 664, 669 (7th Cir. 1997). This requirement prevents the environmental impact statement (EIS) from becoming "a foreordained formality." *City of New York v. Dep't of Transp.*, 715 F.2d 732, 743 (2nd Cir. 1983). *See also Davis v. Mineta*, 302 F.3d 1104 (10th Cir. 2002).

For this PEIS, the broad scope of the proposed action requires a broad range of alternatives. However, the Draft PEIS currently considers only two actual alternatives: the proposed alternative, Alternative B, for leasing on a broad scale and another, Alternative C, for more limited leasing based on existing transmission lines. The Draft PEIS itself states that Alternative A is not an alternative but rather a baseline against which to compare the two action alternatives. Draft PEIS, p. 2-30. This range is insufficient.

Recommendations: The PEIS should incorporate aspects of both alternatives into a broader range and expand the conservation emphasis in the range of alternatives; many additional conservation measures that are within the range between "no leasing" (Alternative A) and making the majority of lands available for leasing (Alternative B) are discussed below and should be included for consideration and in the selected alternative. For example, the agencies could prioritize projects in proximity to existing transmission lines without necessarily precluding projects that are outside of energy corridors. Also, instead of simply evaluating lease applications as received, the agencies could give priority to projects that are in non-controversial locations, have already completed a robust environmental analysis and mitigation plan, and/or sited near existing or planned corridors. The agencies could also phase leasing based on the most well-documented geothermal resources and limit the amount of leasing based on protecting wildlife habitat and other uses. Buffers around existing geothermal resources on lands that are protected from leasing should also be incorporated. A research and development component should also be considered, such that a portion of lands could be leased for experimental technologies, but only on a limited basis in the planning area.

B. The proposed action, Alternative B should not be adopted, because it formally makes the majority lands available for leasing and development without sufficient analysis or protections. O-58-6

Alternative B would make 117 million acres of BLM land and 75 million acres of Forest Service land open to geothermal leasing for direct and indirect use, a total of 192 million acres comprising approximately 77% of the planning area. Draft PEIS, p. 2-7. The Draft PEIS refers to the agencies' discretion in deciding whether to issue leases, but Alternative B does not provide a reasoned approach for exercising this discretion to ensure the best use of our public lands. The decision would be made without sufficient protection for other natural values, such as wilderness characteristics and other recreational or scientific use of geothermal resources. Further, Alternative B would only provide a limited buffer around the geothermal resources in Yellowstone National Park, based on areas that are already protected by a non-discretionary closure (as opposed to the 15 miles in Alternative C). Draft PEIS, p. ES-6. Alternative B also does not encompass practical considerations, such as the availability of transmission, existing or planned, for development.

The Draft PEIS analogizes to the structure of oil and gas leasing. *See, e.g.*, Draft PEIS, pp. 2-6 – 2-7. In the context of oil and gas leasing, issuance of a lease is considered an irretrievable and irreversible commitment of federal resources and, unless issued with a "no surface occupancy" stipulation, cannot be presumed to allow the agencies to retain control to prohibit damage to the environment. *See, e.g., Bob Marshall Alliance v. Hodel*, 852 F.2d 1223, 1227 (9^{th} Cir. 1988); *Pennaco Energy v. U.S. Dept. of Interior*, 377 F.3d 1147, 1160 (10^{th} Cir. 2004). Accordingly, it is important that allocations of land as open to leasing be based on thorough environmental review, in addition to providing for sufficient site-specific analysis to occur prior to leasing. Because the Draft PEIS specifically states that projects can be tiered to the PEIS and not all development will warrant additional environmental analysis, the PEIS must critically analyze the lands that it designates as open to leasing, which requires inventorying the area for wilderness and roadless characteristics and protecting those places with valuable and vulnerable resources. Alternative B does not include sufficient commitments to inventory or to apply protective measures.

Recommendation: The PEIS should not adopt Alternative B.

C. Additional elements required for an approach to be adopted in the PEIS. O-58-7

Alternative C includes significant improvements from Alternative B. This alternative would still make approximately 92 million acres of land available for leasing for commercial transmission. Draft PEIS, p. ES-6. However, there would be a protective 15-mile buffer around the boundary of Yellowstone National Park and leasing would be confined to a 20-mile corridor (10 miles from centerline) from existing transmission lines and those under development, with protective management prescriptions. *Id*. Nonetheless, Alternative C fails to protect additional valuable places and resources that are at risk of damage or destruction if leased for geothermal development.

In order to protect these values, the PEIS must:

1. Expand categories of lands that are closed to leasing.

We agree with the agencies' assessment of categories of certain lands as closed to geothermal leasing, including Wilderness Areas, Wilderness Study Areas, National Conservation Areas, Wild and Scenic Rivers, National Recreation Areas, and other special management areas. However, there are other important areas that must be excluded from geothermal leasing and development.

a) Forest Service Inventoried Roadless Areas O-58-8

The Roadless Area Conservation Rule mandates no new road construction or reconstruction in inventoried roadless areas. *See*, 66 Fed. Reg. 3243, 3270 (January 12, 2001). Further, the Draft PEIS acknowledges that the need for road construction and maintenance for exploration, drilling and utilization phases of geothermal energy development. *See, generally*, Draft PEIS, pp. 2-40 - 2-46. Accordingly, since these lands cannot be developed in accordance with the Roadless Rule, they should not be made available for leasing.

b) Lands with wilderness characteristics

The Draft PEIS states: O-58-9

> BLM has the authority to address lands with wilderness characteristics and describe protective management prescriptions in RMPs. In keeping with the public involvement process that is part of all land use planning efforts, the BLM

will consider public input regarding lands to be managed to maintain wilderness characteristics.

Draft PEIS, 1-25. We appreciate the BLM's acknowledgment of its authority and commitment to public participation in managing lands to protect wilderness characteristics. Since the PEIS will amend as many as 122 land use plans and many RMPs will not be revised for years after the PEIS is finalized, the inventory and protective management of lands with wilderness characteristics should occur as part of this planning process.

Pursuant to FLPMA, "The Secretary shall prepare and maintain on a continuing basis an inventory of all public lands and their resource and other values (including, but not limited to, outdoor recreation and scenic values), giving priority to areas of critical environmental concern. This inventory shall be kept current so as to reflect changes in conditions and to identify new and emerging resource and other values." 43 U.S.C. §1711(a). Wilderness character is a resource for which BLM must keep a current inventory. As the U.S. Court of Appeals for the Ninth Circuit recently held: "wilderness characteristics are among the 'resource and other values' of the public lands to be inventoried under § 1711. BLM's land use plans, which provide for the management of these resources and values, are, again, to 'rely, to the extent it is available, on the inventory of the public lands, their resources, and other values.' 43 U.S.C. § 1712(c)(4)." *Oregon Natural Desert Ass'n v. Bureau of Land Management*, 531 F.3d 1114, 1119 (9th Cir. 2008). Therefore, BLM is required to consider "whether, and to what extent, wilderness values are now present in the planning area outside of existing WSAs and, if so, how the Plan should treat land with such values." *Id*. at 1143.

BLM has defined "wilderness characteristics" to include naturalness and providing opportunities for solitude or primitive recreation. *See* Instruction Memoranda 2003-274, 2003-275, Change 1. These values are to be *identified and protected* in the land use planning process. *See* BLM Land Use Planning Handbook (H-1601-1, 2005); *Oregon Natural Desert Ass'n v. Bureau of Land Management*, *supra*. Further, BLM's national guidance provides for management that emphasizes "the protection of *some or all* of the wilderness characteristics as a priority" over other multiple uses. (emphasis added). This guidance does not limit its application to lands suitable for designation of Wilderness Study Areas; for instance, the guidance does not include a requirement for the lands at issue to generally comprise 5,000-acre parcels or a requirement that the lands have *all* of the potential wilderness characteristics in order to merit protection.

During the scoping process, we provided GIS data regarding lands with wilderness characteristics, which not only constitutes significant new information but also facilitates the agency's review and consideration of protection. In *Oregon Natural Desert Association v. Rasmussen*, CV 05-1616-AS, Findings and Recommendations (D. Or. April 20, 2006); Order (D.Or. Dec. 12, 2006), the court found that BLM's failure to re-inventory lands for wilderness values and to consider the potential impact of decisions regarding management of a grazing allotment violated its obligations under NEPA and FLPMA, then enjoined any implementation of the decision until the agency re-inventoried the lands at issue and prepared an environmental document taking into account the impacts of its decisions on wilderness values. In *Oregon Natural Desert Association v. Rasumussen,* the district court found that BLM had violated NEPA

O-58-10

by failing to consider significant new information on wilderness values and potential impacts on wilderness values, and had also failed to meet its obligations under FLPMA by failing to engage in a continuing inventory of wilderness values. It concluded:

> The court finds BLM did not meet its obligation under NEPA simply by reviewing and critiquing [a local environmental group's] work product. *It was obligated under NEPA to consider whether there were changes in or additions to the wilderness values* within the East-West Gulch, *and whether the proposed action in that area might negatively impact those wilderness values*, if they exist. The court finds BLM did not meet that obligation by relying on the one-time inventory review conducted in 1992. *Such reliance is not consistent with its statutory obligation to engage in a continuing inventory so as to be current on changing conditions and wilderness values*. 43 U.S.C. § 1711(a).
>
> BLM's issuance of the East-West Gulch Projects [environmental analysis] and the accompanying Finding of No Substantial Impact (FONSI) in the absence of current information on wilderness values was arbitrary and capricious, and, therefore, was in violation of NEPA and the [Administrative Procedure Act].

Id. (emphasis added).

The Geothermal PEIS presents an opportunity for the BLM to consider information that has previously been submitted regarding lands with wilderness characteristics in the lands at issue in the PEIS and to inventory these lands, which contain numerous areas proposed for wilderness designation in citizen's wilderness inventories and/or found to have wilderness characteristics. Prior to identifying lands open to geothermal leasing and development, we recommend that the agencies assess information received regarding wilderness characteristics, including inventorying lands identified, and exclude lands with wilderness characteristics, citizen-proposed wilderness, and wilderness inventory units from the lands available for consideration of siting geothermal energy projects.

c) Important habitat and migration corridors

O-58-11

The WGA - consistent with state wildlife action plans - has recently produced the Wildlife Corridors Initiative Report (available at http://www.westgov.org/wga/publicat/wildlife08.pdf), which identifies important wildlife corridors and habitats in the western states and makes recommendations for best protecting these crucial areas. The agencies should consult this report for information on the areas identified and/or confer with the WGA Western Wildlife Habitat Council before completing the PEIS, in order to incorporate this data into decisions regarding which lands will be available for leasing. The agencies should also ensure that additional analysis is conducted, in the PEIS and/or prior to leasing and development, to accurately determine the present of important habitat, including vegetation and migration corridors, and to take appropriate measures to avoid or otherwise mitigate potential damage, as discussed in further detail in the following section of these comments.

d) Places that would be excluded from development under bills pending in Congress O-58-12

All areas that would be closed to geothermal development under bills currently pending in Congress should be excluded from leasing in the PEIS. This should include lands that are included in pending legislation for designation in one of the categories listed as closed to leasing in the Draft PEIS or would otherwise include provisions that prohibit geothermal energy development

e) Appendix with other specific places of concern O-58-13

Appendix A details specific places that are inappropriate for geothermal energy development and/or require special analysis of potential damage to natural and cultural resources prior to leasing and development, including areas around national parks, citizens' inventories or other valuable resources. These areas should be closed to geothermal leasing in the PEIS or upon confirmation of potential damage to the identified values and resources.

2. Designate buffers to protect geothermal resources already prioritized for recreational/scenic values O-58-14

a) Research shows that drilling for geothermal energy in proximity to other known geothermal features can disturb and damage these features.

The National Park Service's web page on Yellowstone's geothermal resources states, "In Iceland and New Zealand, geothermal drill holes and wells 2.5 - 6.2 miles distant have reduced geyser activity and hot spring discharge." (http://www.nps.gov/yell/naturescience/geothermalresources.htm) This confirms the necessity of creating buffer zones around geothermal resources with surface features that are part of protected areas, such as national parks, or have been identified for the recreational and scenic values. Disturbances to these features would have major economic and environmental impacts on our national parks and other areas with geothermal resources. Tourism would decrease as a result of loss of thermal features, and endemic species that depend on the geothermal resources of the area would likely suffer.

The New Zealand Geothermal Association provides evidence of damage caused to thermal features as a result of geothermal development that is not well-planned. Some environmental effects that have been documented in New Zealand include loss of active geysers, unsustainable draw down, and subsidence. According to the association, "Of more than 200 geysers active in the central North Island in the 1950s, only about 40 remain." (http://www.nzgeothermal.org.nz/environmental/surface_effects.asp) These potential impacts are unique to geothermal resources, and therefore must be analyzed thoroughly.

b) Additional protections around Yellowstone National Park.

O-58-15

The PEIS must include a buffer around Yellowstone National Park in order to protect the thermal features found there. According to the National Park Service, 75% of the world's geysers are located in Yellowstone. The NPS warns that "research is needed to determine the extent to which YNP's geothermal systems connect with areas of lease application west and north of the boundary." (http://www.nps.gov/yell/naturescience/geothermalresources.htm) Clearly, the necessary scientific research substantiating the effects that geothermal development could have on the park's features is not yet adequate. While Alternative C would provide a 15 mile buffer and close the Island Park Geothermal Area to leasing, further analysis and protections are needed.

(1) Background

The geothermal features in Yellowstone National Park were largely responsible for its designation as this country's first national park in 1872. These features are a global treasure. Nowhere else in the world can you find the array or number of geysers, hot springs, mud pots, and fumaroles found in Yellowstone. More than 75% of the world's geysers, including the world's largest are in Yellowstone's seven major basins.

As stated above, in almost every other geyser area in the world, including those in New Zealand, Iceland, China and the United States, development has seriously affected or permanently destroyed the thermal features of those areas. The park's thermal features lie in the only essentially undisturbed geyser basin left worldwide. Ten miles north of Yellowstone, research has demonstrated that the LaDuke Hot Springs are connected to geothermal features within Yellowstone.

(2) Montana & U.S. Water Compact, Yellowstone Controlled Groundwater Area

O-58-16

As a national park, the lands within Yellowstone's boundary are protected by statute from geothermal leasing. Other existing statutes are in existence to protect Yellowstone's geothermal features such as the Island Park Known Geothermal Resource Area and wilderness designations and given necessary deference within the Draft PEIS. However, a significant agreement ratified in 1993 by the State of Montana and the U.S. Government has not been acknowledged or considered within the Draft PEIS. That agreement is the Water Rights Compact between the State of Montana and United States of America, National Park Service (http://data.opi.state.mt.us/bills/mca/85/20/85-20-401.htm).

The State of Montana and the National Park Service entered into a Water Rights Compact on May 12, 1993 that committed the two entities to protecting the geothermal integrity of Yellowstone National Park. This agreement designated and provided protections for the Yellowstone Controlled Groundwater Area in Montana. The statement of intent for the Yellowstone Controlled Groundwater Area is as follows:

> Yellowstone National Park was reserved for the express purpose of "preservation, from injury or spoliation, of all timber, mineral deposits, natural curiosities, or wonders within said park, and their retention in their natural condition." (17 Stat. 32.) The parties agree

that Congress reserved water necessary to preserve the hydrothermal features within the reserved land of YNP. These reserved water rights have priorities as of the date on which the land was reserved.

The parties understand that knowledge of the interrelationship of hydrothermal features within YNP, the hydrothermal system that supports those features, and groundwater in surrounding areas of Montana will benefit from increased study. The parties agree that the hydrothermal features of YNP are a unique and irreplaceable resource and represent one of the few undisturbed hydrothermal systems in the United States.

This Compact does not recognize a reserved water right to groundwater outside the boundaries of the reserved land of YNP. However, the parties agree that restrictions shall be placed on the development of groundwater adjacent to YNP to the extent necessary to prevent adverse effect on the reserved water right to groundwater within YNP. *The parties agree that the goal of establishment and administration of the Yellowstone Controlled Groundwater Area shall be to allow no impact to the hydrothermal system within the reserved land of YNP.*

Water Rights Compact between the State of Montana and United States of America, National Park Service, Article IV "Yellowstone Controlled Groundwater Area", Section A (emphasis added)

Article IV went on to indicate that research was limited at the time of signing, and more was necessary to fully understand the interconnectedness of Yellowstone National Park and adjacent lands. A provisional Yellowstone Controlled Groundwater Area was established in 1993, but a commissioned Technical Oversight Committee established a scientifically-based boundary for the Area which is provided in the enclosed map. in Article IV went on to indicate that research was limited at the time of signing, and more was necessary to fully understand the interconnectedness of Yellowstone National Park and adjacent lands. A provisional Yellowstone Controlled Groundwater Area was established in 1993, but a commissioned Technical Oversight Committee established a scientifically-based boundary for the Area inwhich is provided in the enclosed map.

Given the State of Montana's and the U.S. Government's commitment to protecting the integrity of Yellowstone's geothermal resources through the designation of the Yellowstone Controlled Groundwater Area through the Water Rights Compact, the Yellowstone Controlled Groundwater Area must be withdrawn from any consideration for geothermal leasing under this programmatic EIS.

<u>Recommendation</u>: Geothermal leasing is prohibited within the Yellowstone Controlled Groundwater Area established through the 1993 Water Rights Compact between the State of Montana and United States of America, National Park Service.

(3) Areas not covered by the Island Park Known Geothermal Area and the Yellowstone Controlled Groundwater Area 0-58-17

Outside the Island Park Known Geothermal Resource Area and the Yellowstone Controlled Groundwater Area, existing research on areas adjacent to Yellowstone is for the most part lacking or inadequate. Moreover, it is likely that other important aquifers with hydrologic links to Yellowstone National Park exist but have yet to be designated as Known Geothermal Resource Areas.

Alternative C in the Draft PEIS recognizes the importance of Yellowstone's geothermal resources by prohibiting geothermal leasing within fifteen miles adjacent to the Park in addition to the protections provided by statute to the Island Park Known Geothermal Resource Area. As discussed above, a prohibition of geothermal leasing adjacent to Yellowstone will provide inadequate protection unless it includes the entire Yellowstone Controlled Groundwater Area in the State of Montana.

It must be recognized in the Final PEIS that in some instances fifteen miles may not provide adequate protection of Yellowstone's geothermal resources. For any geothermal leasing proposals outside the Island Park and Yellowstone controlled areas and up to fifty miles from the park boundary, the Park Service should be given the opportunity to consult as to whether or not the proposed activity might interfere with the natural function of any geothermal feature or hydraulically linked aquifer in Yellowstone Park. When current science and technology cannot provide absolute assurance regarding the effect of a proposed action on geothermal resources in Yellowstone Park, then that activity should be prohibited on federal land and private lands with federal mineral rights.

Recommendation: Use of geothermal resources as an energy source should not be pursued in areas where a hydrologic link with Yellowstone National Park geothermal features is possible. A permanent ban should be placed on all geothermal development on federal lands within a 15-mile radius of Yellowstone Park. The protected area should be expanded to fully incorporate the Island Park Geothermal Area (a minimum of 32 miles outside Yellowstone Park) and, in Montana, the Yellowstone Controlled Groundwater Area. In addition, the National Park Service should be provided a formal consultation role in any proposal beyond the protected buffer, up to fifty miles from the park boundary.

c) Identify other areas where buffers are necessary due to protected geothermal resources (including other national parks or national monuments that exist due to presence of geothermal resources O-58-18

The agencies must work with the National Park Service (NPS) and other agencies and organizations to determine where geothermal features exist that could potentially be impacted by development. Although national parks and monuments are not open to leasing in the PEIS, buffer zones around these sites must also be identified and closed to leasing where necessary to protect the resources.

The Draft PEIS makes no reference to the Geothermal Steam Act Amendments of 1988, which require the Secretary of the Interior to maintain a list of NPS units with significant thermal features, monitor the features (with priority to those in proximity to current, proposed or potential geothermal development), deny lease applications that would result in a significant adverse effect to the thermal features and ensure that all leases and permits include stipulations to protect the significant thermal features. 30 U.S.C. § 1026. As discussed above, geothermal development can affect geothermal features at a distance of miles. Geothermal leases that have the potential to impact a significant thermal feature must either be denied or granted with compulsory stipulations to protect the resource. The 1988 amendments *require* that impacts to thermal features within the National Park System are considered in geothermal leasing and development. The testimony submitted by the National Parks Conservation Association (NPCA) in connection with the 1988 amendments highlights the potential risk to geothermal features that propelled this legislation. *See,* Statement of Destry Jarvis, Vice President for Conservation Policy, NPCA - attached to these comments. NPCA's testimony also provides important information on other NPS lands that could be negatively impacted by geothermal energy development, listing lands with volcanic and thermal activity or features and those that, at the time of the testimony, were already identified as having high potential for development. *Id*. These lands, due to their features, remain at risk and due special consideration; they are also set out in Appendix A to these comments.

Recommendation: The Final PEIS must incorporate the list of significant thermal features within the NPS and ensure that the formal consultation with the NPS occurs for any leasing and/or development activities with the potential to impact these features.

3. Identify and prioritize for leasing places that would be more appropriate for geothermal

In addition to avoiding ecologically-sensitive lands, the PEIS can identify areas that are more likely to be suitable for development and non-controversial; and leasing could be prioritized in these areas. Factors that should be considered are set out below.

a) Impaired or degraded lands

O-58-19

The PEIS should require that lands that are already impaired be considered first for proposed geothermal development. Abandoned mines, developed oil and gas fields, and other brownfields, which are not being restored to ecological function, provide opportunities for geothermal energy development without loss of other uses and values. Such sites are often close to existing infrastructure, which is another important consideration, both in conjunction with degraded sites and as a separate factor.

b) Proximity to existing infrastructure

O-58-20

Proximity to existing infrastructure will minimize new road construction or major roadway improvements (such as paving and widening), avoiding another set of impacts on the public lands. Further, proximity to the load that will be served by the project will limit the amount of new transmission needed and reduce related income.

c) Co-siting with solar energy projects

O-58-21

Federal land agencies are currently in the process of completing a PEIS for solar energy development as well. Both solar and geothermal energy are long-term, industrial uses of public lands. While we support the development of renewable, clean energy sources, we encourage the agencies to mitigate the impacts of all energy development to the extent possible. One mitigation measure that could prove greatly beneficial is the possibility of co-siting geothermal and solar energy projects, thereby reducing environmental impacts. The agencies should explore this possibility in the PEIS, and create terms to encourage this type of development.

d) Siting to maximize use of transmission for renewable energy

The federal agencies are involved in designation of transmission corridors on public lands and national forests, including the West-wide Energy Corridor PEIS. Individual states are engaged in designation of zones to prioritize development and transmission of renewable energy, such as California's Renewable Energy Transmission Initiative and Nevada's Renewable Energy Zones. The Western Governors Association (WGA) is undertaking an initiative to designate Renewable Energy Zones. Prioritizing lands for lease and development that are within these zones or in proximity to other approved renewable energy development projects will maximize access to transmission. This approach should also be incorporated into the PEIS. O-58-22

e) Possibility of land exchange O-58-23

The agencies should consider land exchange as a mitigation measure for geothermal development due to the industrial and long-term use of public lands.

4. Conduct strategic leasing or use conditional development stipulations

Because the current BLM geothermal program is very small in scale when compared to the reasonably foreseeable development scenario laid out in the Draft PEIS, the agencies should conduct strategic leasing to prioritize areas that are not controversial and have proven technology, to limit leasing on unknown technologies until they are proven successful both in the utilization phase and in the reclamation phase. O-58-24

We also reiterate our scoping comment that the PEIS should analyze the use of conditional-development lease stipulations. As it is often difficult at the time of leasing to have the best data on site-specific impacts for future geothermal full-field development within an area, a leasing stipulation that conditions the right of development on the results of future and more-detailed studies provides an opportunity to clarify that development may ultimately be limited. This type of stipulation could also be used to support a research and development program, as discussed below.

5. Restrict development initially to traditional geothermal resources and/or established technology; commit to an R&D leasing program to develop additional technologies O-58-25

a) Only technologies analyzed in this PEIS can be approved by tiering to the PEIS and important to use R&D leasing

It is essential that the PEIS clearly states that only geothermal technologies described and analyzed for impacts in the PEIS can be tiered to this document. These are specifically dry steam, flash steam, and binary-cycle power plants.

b) The agencies should support a program for developing new technologies, using R&D leasing O-58-26

While we support research and development (R&D) of new geothermal technologies, especially those that reduce impacts on public lands by utilizing heat differential technology and thus do not require use of limited water sources, R&D activities require new NEPA analysis. Applications for R&D, including "enhanced geothermal systems," cannot be tiered to this PEIS because their impacts are not analyzed in the document. However, the PEIS could describe and commit the agencies to develop and support a R&D leasing program for new technologies, which could be facilitated through the use of conditional development leases.

Recommendation: The management alternative to be selected for the PEIS should include the protective and proactive measures described above.

III. The PEIS Does Not Adequately Assess Environmental Consequences to Key Resources.

NEPA requires that the scope of environmental analysis be commensurate with the proposed action. *Kern v. United States Bureau of Land Management,* 284 F.3d 1062, 1072 (9th Cir. 2002). In light of the multistate range of lands and millions of acres that would be affected by the decisions in the PEIS, a more thorough analysis of potential impacts to other resources and values is necessary, as detailed below.

A. The agencies are required to assess the planning projects of other federal agencies and local governments in order to provide adequate cumulative impact analysis.

O-58-27

NEPA requires the agencies to consider the cumulative impacts of and related to the PEIS. NEPA regulations define "cumulative impact" as:

> the impact on the environment which results from the *incremental impact of the action when added to other past, present, and reasonably foreseeable future actions* regardless of what agency (Federal or non-Federal) or person undertakes such other actions. *Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time*.

40 C.F.R. § 1508.7 (emphasis added).

To satisfy NEPA's hard look requirement, the cumulative impacts assessment must do two things. First, BLM must catalogue the past, present, and reasonably foreseeable projects in the area that might impact the environment. *Muckleshoot Indian Tribe v. U.S. Forest Service,* 177 F.3d 800, 809–10 (9th Cir. 1999). Second, BLM must analyze these impacts in light of the proposed action. *Id.* If BLM determines that certain actions are not relevant to the cumulative impacts analysis, it must "demonstrat[e] the scientific basis for this assertion." *Sierra Club v. Bosworth,* 199 F.Supp.2d 971, 983 (N.D. Ca. 2002). A failure to include a cumulative impact analysis of actions within a larger region will render NEPA analysis insufficient. *See, e.g., Kern* *v. U.S. Bureau of Land Management*, 284 F.3d 1062, 1078 (9th Cir. 2002) (analysis of root fungus on cedar timber sales was necessary for an entire area).

This definition clearly encompasses the other large-scale energy development being planned for the same lands under analysis in this PEIS, which will inevitably compound the effects of leasing and development of geothermal energy on the natural resources of our public lands, such as wildlife habitat, wilderness character and roadlessness, water, scenic beauty, and cultural resources.

Further, NEPA, as explained by the Council on Environmental Quality, also directs agencies to consider potential conflicts with the objectives of other plans, policies or controls, which requires an assessment of possibilities for resolving conflicts and a thorough consideration of how not resolving the conflict could "impair the effectiveness of land use control mechanisms for the area." 40 C.F.R. § 1502.16(c); *Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations*, 23a. Similarly, FLPMA requires that the BLM's guidance and management policies shall "be consistent with officially approved and adopted resource related policies and programs of other Federal agencies, State and local governments and Indian tribes." 43 U.S.C. § 1712(c)(9); 43 C.F.R. § 1610.3-2.

There are currently several major planning processes underway in the Western United States that we want to highlight for the BLM to address in the Geothermal PEIS because of the potential overlap in goals. California's Renewable Energy Transmission Initiative (RETI), the Western Governors Association's Western Renewable Energy Zones (WREZ), and the West-wide Energy Corridors PEIS are all transmission initiatives in the project area. The states of Colorado, New Mexico, and Nevada also have initiatives to identify locations and provide incentives for renewable energy development and transmission.

The West-wide Energy Corridor PEIS is of particular relevance to the Geothermal PEIS. These two processes should be viewed as an opportunity for synergy and as an opportunity to bring more renewable energy into the American electricity grid while minimizing environmental degradation. If both energy corridors and geothermal energy development projects are properly sited and renewable technologies such as solar, wind, and geothermal energy are given preference in new transmission rights-of-way within the corridors, these efforts together can help America reduce its reliance on the fossil fuels responsible for global climate change. Currently, the West-wide Energy Corridor PEIS is the subject of significant controversy, due to the failure to assess the need for corridors to support renewable energy, as well as the failure to avoid ecologically important areas. Although the Draft PEIS makes note of this initiative, it fails to provide analysis of the cumulative impacts that will result from both of these programs being established in the same project area.

In addition, BLM is preparing a solar energy program and oil shale/tar sands program and has recently completed a wind energy program. All of these planning processes impact lands in the western states and will utilize transmission corridors, and in combination have the potential to disturb a majority of public and Forest Service lands in the West.

Chapter 5 of the Draft PEIS states that geothermal development would have a minor cumulative impact on resources such as vegetation and soil due to its comparatively small footprint: "The contribution to cumulative impacts of geothermal projects on public and FS lands would be small or negligible unless a significant permanent, uncompensated loss of the current productive use of a site occurred, or if future uses were precluded" Draft PEIS at 5-18. However, in context of a small area cleared for geothermal, and other areas all over the West cleared for solar, wind, oil shale, and transmission for all of these energy sources, the cumulative impacts can actually be expected to be quite large, with geothermal development making a significant contribution. In addition, because transmission will be necessary for indirect use geothermal projects, it is imperative that the agencies analyze transmission initiatives in the project area and provide cumulative impact analysis. Disregard of these processes may lead to duplicative corridors and unnecessary lands, wildlife and natural resource impacts.

Before preparing the Final PEIS, the agencies must go back and analyze not just the small impacts from geothermal plants, but the *cumulative* impacts of geothermal plants and transmission in context with solar plants, wind turbines, oil shale and tar sands mines, and the many other planning processes in the project area.

Recommendation: Because leasing of land for geothermal development is a commitment of the resource for future exploration and development, the agencies must conduct cumulative impact analysis of reasonably foreseeable future actions in context of other energy development and transmission projects in the western states.

B. Socioeconomic analysis.

There are several areas where the Draft PEIS for Geothermal Leasing in the Western US (Draft PEIS) falls short in the analysis of the potential socioeconomic impacts associated with leasing public lands for the development of geothermal energy. These are described briefly below and discussed in greater detail in the sections which follow.

1) The socioeconomic analysis in the Draft PEIS is superficial and is based heavily on documents that were produced by the geothermal energy industry itself.

2) The analysis of the socioeconomic impacts is one-sided, focusing only on the potential benefits of geothermal energy development without assessing the potential costs of such development on public lands.

    a. The Draft PEIS fails to address the potential impacts to rural economies from potential impacts to public lands. Many economies benefit from undeveloped public lands and this potential impact should be analyzed in the Final EIS.

    b. The Draft PEIS does not account for the non-market values, including the impacts on local quality of life, which are associated with the undeveloped public lands that may be impacted by geothermal energy development.

These specific concerns are discussed in detail in the sections below.

1. **The socioeconomic analysis in the Draft PEIS is superficial and is based heavily on documents that were produced by the geothermal energy industry itself.** O-58-28

The Draft PEIS presents only the most general estimates of the potential jobs and royalties (and these are based only on industry references), without any in-depth analysis or even a qualitative discussion of the overall potential socioeconomic impacts associated with large scale developments on public lands in rural areas.

The socioeconomic analysis in the Draft PEIS refers frequently to several documents which were produced by or for geothermal industry advocacy groups. One of these documents is a two-page promotional document touting only the potential beneficial economic impacts of the industry. They are clearly self-serving for this specific industry and while potentially a valuable source of information, they should not be the only source of information about the socioeconomic impacts of large-scale geothermal energy development on public lands.

In preparing the Final EIS the BLM and FS should do a review of the economic literature on modern rural economies and include analysis of a broader range of impacts. The agencies should also include input and research from a more broad range or sources, rather then relying solely on industry analyses.

2. **The analysis of the socioeconomic impacts is one-sided, focusing only on the potential benefits of geothermal energy development without assessing the potential costs of such development on public lands.** O-58-29

While it is certainly possible that the benefits to local communities from geothermal energy development may be substantial, it is also quite likely that such development will have certain costs as well. The Draft PEIS does not analyze the potential costs associated with leasing millions of acres of BLM and FS lands for geothermal energy. The Draft PEIS merely assumes that mitigation, stipulations and BMPs will result in minimal impacts.

Western communities often face the need to balance extractive development and other industrial uses of the region's abundant public lands with the economic and aesthetic benefits that are derived from these lands in their undeveloped state. The economy of the western United States has long been viewed as one dependent upon the extraction of natural resources. However, recent research has shown that this assumption is no longer valid. Commercial geothermal development would be yet another such industrial use, with many of the attendant pitfalls and issues. Yet the Geothermal DPIES does not assess the impacts associated with continued reliance on extraction industries in the context of the changing economy of the region.

a) **The Draft PEIS fails to address the potential impacts to rural economies which benefit from undeveloped public lands – lands which will be impacted by the development of geothermal energy projects and related transmission corridors.** O-58-30

The omission of the potential costs to the western economies affected is reflected in the list (on page 4-139 of the Draft PEIS) detailing the conditions under which potential impacts on socioeconomics and environmental justice could occur. This list focuses very narrowly on commodity impacts, jobs and income in the geothermal industry, and revenues from royalties and taxes that might accrue. The list mentions the potential for increases in population and the potential for these increases to strain local resources; however, the analysis does not treat this potential impact with any depth. Missing from the list are the potential impacts on businesses and individuals who may rely on the presence of protected public lands to attract employees, to attract customers or for their own quality of life.

In the last 30 years, the West has evolved beyond being a region whose economy was largely focused on extractive industries, into a more diverse economy (Bennett and McBeth, 1998; Johnson, 2001). As the economies of rural communities in the West evolve, the impact of public land management on these economies also evolves, and the management of our public lands must as well. Sociological and economic research conducted over the last two-plus decades indicates that the environmental amenities provided by public lands are an important economic driver in the rural West. For several examples see: Rudzitis and Johansen, 1989; Johnson and Rasker, 1993, 1995; Rasker 1994; Power, 1995, 1996; Duffy-Deno, 1998; Rudzitis, 1999; Rasker,et al. 2004; Holmes and Hecox, 2004; Whitelaw, et al. 2003.

These indicators include the growing importance of non-labor income from investments and retirement, increasing employment in high technology, knowledge-based, and service industries, the important role that recreation and tourism plays in providing jobs and income, and the rise of small businesses and other entrepreneurial endeavors. The Draft PEIS fails to analyze or account for negative impacts on these segments of the economy. Large scale geothermal energy development is likely to have negative impacts such as habitat fragmentations, loss of quality of life, loss of quality recreation, and reduced quality of hunting and fishing. These impacts can, in turn, have detrimental consequences for non-traditional sectors of the economy which have come into prominence in the West. These non-traditional sectors have been shown to rely upon protected, undeveloped public lands. Such lands enhance the attractiveness of rural western communities for businesses, workers and retirees who are not tied to specific locations for income or employment. These sectors have for decades been the largest portion of almost every county in the U.S.

The recreation opportunities alone provided by wilderness quality and other undeveloped public lands yield direct economic benefits to local communities. The Draft PEIS socio-economic analysis does not include an analysis of the income and jobs associated with recreation, hunting and fishing from each alternative. In our scooping comments, we included a document entitled "Socio-Economic Framework for Public Land Management Planning: Indicators for the West's Economy," which details our expectations for the baseline analysis of the region's economy as well as the analysis of the potential impacts of this program. We request that you re-review the document and that your analysis for the Final EIS follow the approach set out in this document.

b) The Draft PEIS does not account for the non-market values, including the impacts on local quality of life, which are associated with the undeveloped public lands that may be impacted by geothermal energy development. O-58-31

Public lands provide numerous values, some of which are realized when natural resources are extracted, and others which require that the natural ecosystems remain intact. The benefits of these various values often flow to different groups or individuals. Some of the benefits from public lands are more likely to flow to individuals or companies (market benefits), and others are available for the entire population (non-market benefits).

Any time that unique or irreplaceable resources or values are at risk, there is a strong component of non-market value which must be assessed. One of the primary purposes of the public lands system is the provision of public goods such as the protection of unique landscapes, ecological diversity, wildlife habitat, wilderness, and cultural and archeological resources. Large-scale geothermal energy development may put these resources at risk.

To facilitate informed decisions about publicly owned wildlands, economic analysis must take into consideration both market and nonmarket benefits and costs (Loomis 1993). It is important that the FS and BLM examine both market and non-market benefits and costs of large-scale geothermal energy development. Non-market benefits must be measured and compared with the market benefits that accrue to companies and individuals when undeveloped public lands are developed.

In analyzing the socioeconomic impacts of geothermal energy leasing and development, the agencies must complete a full accounting of the costs and benefits associated with this development including non-market costs and benefits. The agencies' accounting should recognize the multiple use aspects and the full extent and value of existing wilderness character and wildlands as a resource within and near new geothermal energy development, which include formally designated Wilderness and Wilderness Study Areas, as well as other areas with wilderness and special characteristics identified by citizens and proposed for protective management. The multiple benefits that derive from protecting wilderness quality and other undeveloped lands include positive economic impacts to local communities. In developing the Final EIS, the agencies should analyze the benefits of protecting all existing wilderness character and wildlands against impairment from large-scale geothermal energy development, and should also consider how managing these lands will affect wildlands and wildlife in other locations and in turn the economies in local communities.

Recommendations: In preparing the Final EIS for geothermal leasing, the BLM and FS must:

- consider the increasing importance of industries and economic sectors that rely on public lands for environmental amenities;
- examine the potential impacts that large-scale geothermal development on public lands may have on key indicators which characterize the modern western economy; and

- estimate the potential non-market benefits and costs associated with large-scale geothermal energy.

C. Visual resources

O-58-32

NEPA requires the agencies to "assure for all Americans . . . aesthetically . . . pleasing surroundings." 42 U.S.C. § 4331(b)(2). FLPMA specifically directs the BLM to prepare and maintain inventories of the visual values of all public lands, 43 U.S.C. § 1711(a), and manage public lands "in a manner that will protect the quality of . . . scenic . . . values," §1701(a)(8). BLM has interpreted these mandates as a "stewardship responsibility" to "protect visual values on public lands" by managing all BLM-administered lands "in a manner which will protect the quality of the scenic (visual) values." BLM Manual 8400 – Visual Resource Management .02, .06(A). BLM utilizes visual resource inventories during its land use planning process to establish management objectives, organized into four classes. These objectives are as binding as any other resource objectives contained in the RMP. *See Southern Utah Wilderness Alliance*, 144 IBLA 70, 84 (1998).

These statutory and regulatory responsibilities are especially important because of the scenic values associated with use and enjoyment of the public lands and national forests, and also with the use and enjoyment of geothermal areas, specifically. The agencies should ensure that natural settings are protected – these settings are often vital to local and regional economies and for cultural resources. Viewsheds and scenic values should be considered as a factor for establishing buffers of protection from surface disturbance.

D. Wildlife habitat and fragmentation analysis

O-58-33

1) Endemic species

There are numerous species that rely on the geothermal characteristics of their habitat for survival. The PEIS should clearly identify these species, their range, and appropriate protections.

2) Habitat fragmentation analysis

O-58-34

Significant portions of the land that will be considered for geothermal energy development in the PEIS contain core habitat areas and migration linkages between those core areas, all of which need to be preserved in order for the regional ecosystems to continue to function. Fragmentation of wildlife habitat affects the ecological composition, structure, and functions of a landscape. Habitat fragmentation has been defined as the "creation of a complex mosaic of spatial and successional habitats from formerly contiguous habitat" (Lehmkuhl and Ruggiero 1991). **Although fragmentation can be difficult to measure, there are a variety of metrics that can be used to assess the degree of existing habitat fragmentation and the condition of the landscape, then applied to available data regarding distribution of wildlife and habitat, and ultimately used to make decisions regarding appropriate locations for geothermal energy projects. We recommend that the agencies complete such an analysis as part of the PEIS.**

Existing road density can be calculated by measuring the length of linear features in a given sub-area at regular intervals and then reported as miles of route per square mile (mi/mi^2). The degree of habitat fragmentation, the distribution of unroaded areas, or core areas, can also be measured and calculated based on the amount of land beyond a given distance or effect zone, from transportation routes (Forman, 1999). Wildlife species respond to disturbances related to this type of network at varying distances, so determining the size distribution of core areas for a range of effect zones (i.e., of 100ft, 250ft, 500ft and 1320ft) from all routes is also important. Wildlife literature will yield information on the effect zones for different species. For instance, an ongoing study by Sawyer et al. (2005, 2004, 2001) of GPS collared deer on the Pinedale Anticline observed that deer utilized habitat progressively further from roads and well pads over three years of increasing gas development and showed no evidence of acclimating to energy-related infrastructure. Birds are also impacted by roads and management practices associated with energy development, due to fragmentation, changes in vegetation and noise (Mabey and Paul, 2007; Robel, et al., 2004).

In addition to geothermal projects themselves, habitat fragmentation can be caused by transmission corridors, which will be necessary to transmit geothermal energy to electricity grids. Wildlife habitat fragmentation caused by transmission lines, pipelines, and roads generally fall into three broad categories:

1. Construction impacts (access, right-of-way clearing, construction of towers, stringing of cables);
2. Line maintenance impacts (inspection and repair); and
3. Impacts related to the physical presence and operation of the transmission line.

As such, wildlife habitat must be examined on an individual project and site-specific basis. The only way to accomplish this requirement is to ensure that each individual geothermal project is spatially evaluated for direct, indirect and cumulative impacts.

Specific activities that negatively impact wildlife and cause destruction of core habitat or habitat fragmentation include the construction of facilities, disturbance of soil by the use of heavy machinery, site clearing and grading, noisy machinery during construction and maintenance, removal of vegetation, use of herbicides, well drilling, and accidental release of hazardous materials.

The effects of these activities on wildlife can be severe and include removal of habitat, fragmentation of habitat, and the creation of edge effect vegetation and habitat (changes in composition, structure, microclimate, etc. of area adjacent to facility and transmission corridor). Species shown to avoid edges include red-backed vole, snowshoe hair, pine marten and red squirrels. In addition, it is logical to suspect that construction of facilities and transmission in previously undisturbed areas will lead to a direct loss of life to wildlife during construction, operation and service of transmission lines.

We have included The Wilderness Society's most recent Science and Policy Brief, "Habitat Fragmentation from Roads: Travel Planning Methods to Safeguard BLM Lands". This report provides a summary of available scholarly and government reports and studies on the impact of habitat fragmentation on wildlife, provides methods for calculating habitat fragmentation, and provides recommendations on how to integrate fragmentation analysis into management. BLM should use the information provided in this brief (as well as related information from State Wildlife Action Plans, Audubon Important Bird Areas, and the Wildlands Network) to identify core areas, measure habitat fragmentation, conduct a thorough fragmentation analysis, and inform decisions regarding designation of lands as available for geothermal energy in the PEIS, as well as incorporating these requirements into the PEIS to guide analysis of specific projects.

E. Wilderness and/or roadless characteristics

O-58-35

As mentioned above, because the PEIS will be used to amend land use plans and tiered to in analyzing specific projects, the agencies must inventory the project area for lands with wilderness and/or roadless characteristics and exclude these areas from leasing and development, in order to prevent destruction of these values.

F. Cultural resources

O-58-36

Native and prehistoric cultures also prize geothermal resources, such that there is a significant overlap between geothermal resources and sacred sites. The National Historic Preservation Act affords heightened protection to these resources, establishing a cooperative federal-state program for the protection of historic and cultural resources. In particular, the review process set out in Section 106 (16 U.S.C. § 470f) obligates the agencies to consider the effects of management actions on historic and cultural resources listed or eligible for inclusion under NHPA. Further, Section 110 of the NHPA requires the BLM to assume responsibility for the preservation of historic properties it owns or controls (16 U.S.C. § 470h-2(a)(1)), and to manage and maintain those resources in a way that gives “special consideration” to preserving their historic, archaeological, and cultural values. Section 110 also requires the BLM to ensure that all historic properties within the National Monument are identified, evaluated, and nominated to the National Register of Historic Places. *Id*. § 470h-2(a)(2)(A).

The agencies must place special importance on consultation with Tribes and the PEIS should comment to a specific plan for ensuring identification, evaluation, nomination and protection of cultural resources prior to issuing leases. Further, places where Tribes have already raised concerns and those where there is known to be a significant concentration or high potential for such a concentration of cultural resources should be excluded or avoided from those lands prioritized for leasing and development.

G. GIS Data

O-58-37

As stated in our scoping comments, geographic information systems (GIS) data is critical for ensuring that existing resources can be mapped and considered in this PEIS and subsequent decisions. The agencies should not only obtain and analyze this data, they should also make it available to the public for use in understanding and commenting on impacts, as was done with the West-wide Energy Corridors Draft PEIS.

1) Lands with wilderness characteristics and proposed wilderness: GIS layers needed to complete the PEIS. 0-58-38

Prior to identifying areas appropriate for geothermal energy development as part of the PEIS, it is imperative that the agencies gather the necessary information to ensure that wilderness quality lands are not disturbed. The agencies have before them a unique opportunity to act as stewards of the public domain on a west-wide scale. By collecting and using appropriate GIS data layers before considering appropriate places for geothermal leasing and development, the agencies can ensure that they avoid disturbing our nation's wild places. **We recommend that the agencies collect and use the following GIS data layers to map areas that are unacceptable for siting geothermal projects and in siting projects to avoid impacting the identified areas:**

State	Contact Information	
Alaska	**Address:** The Wilderness Society, Alaska 705 Christensen Drive Anchorage, AK 99501 **Website:** www.wilderness.org	**Phone:** (907) 272-9453 **Email:** ak_office@tws.org
Arizona	**Address:** Arizona Wilderness Coalition PO Box 529 Alpine, AZ 85920 **Website:** www.azwild.org	**Phone:** (928) 339-4426 **Email:** azwild@azwild.org
California	**Address:** California Wilderness Coalition 1212 Broadway, Suite 1700 Oakland, CA 94612 **Website:** www.calwild.org	**Phone:** (510) 451-1450 **Email:** info@calwild.org
Colorado	**Address:** Colorado Environmental Coalition 1536 Wynkoop Street #5C Denver, CO 80202 **Website:** www.ourcolorado.org	**Phone:** (303) 534-7066 **Email:** info@cecenviro.org
Idaho	**Address:** The Wilderness Society, Idaho 950 W. Bannock Street Suite 605 Boise, ID 83702 **Website:** www.wilderness.org	**Phone:** (208) 343-8153 **Email:** brad_brooks@tws.org
Montana	**Address:** Montana Wilderness Association PO Box 635 Helena, MT 59624	**Phone:** (406) 443-7350 **Email:** mwa@wildmontana.org

	Website: www.wildmontana.org	
Nevada	**Address:** Nevada Wilderness Project 8550 White Fir Street Reno, NV 89523 **Website:** http://www.wildnevada.org	**Phone:** (202) 266-0465 **Email:**
New Mexico	**Address:** New Mexico Wilderness Alliance 202 Central SE Suite 101 Albuquerque, NM 87102 **Website:** www.nmwild.org	**Phone:** (505) 843-8696 **Email:** Emailnmwa@nmwild.org
Oregon	**Address:** Oregon Wild 5825 North Greeley Portland, OR 97217-4145 **Website:** www.oregonwild.org	**Phone:** (503) 283-6343 **Email:** info@oregonwild.org
Utah	**Address:** The Wild Utah Project 68 South Main Street, Suite 400 Salt Lake City, UT 84101 **Website:** http://www.wildutahproject.org	**Phone:** (801) 328-3550 **Email:** wup@xmission.com
Washington	**Address:** The Wilderness Society, Seattle 720 3rd Avenue, Suite 1800 Seattle, WA 98104 **Website:** www.wilderness.org	**Phone:** (206) 624-6430 **Email:** bob_freimark@tws.org
Wyoming	**Address:** Biodiversity Conservation Alliance P.O. Box 1512 Laramie, WY 82073 **Website:** www.biodiversityassociates.org	**Phone:** (307) 742-7978 **Email:** erik@voiceforthewild.org

Attached with the hard copy of these comments is a CD of GIS data for all available citizen-proposed wilderness areas for Colorado, Idaho, New Mexico, Utah, and Wyoming, current as of September 2008. The offices above can always be contacted for the most current versions of these data; GIS data for Citizen Proposed Wilderness Areas for Alaska, Arizona, California, Montana, Nevada, Oregon, and Washington can be obtained by contacting the offices above.

Many lands with wilderness characteristics have been inventoried and mapped by BLM field offices as part of RMP revisions. BLM should use this data to identify exclusion areas for geothermal leasing. Further, in identifying additional lands with wilderness characteristics, BLM should use GIS mapping to identify exclusion areas, and the agency should make these data layers available to the public as part of their PEIS.

2) Other GIS layers needed to complete the PEIS

As stated above, because the siting of geothermal projects will have significant and long lasting impacts on public lands, it is critical that the agency gather, analyze, and make available to the public any GIS layers which describe sensitive or protected areas. In addition to the lands with wilderness characteristics, citizen proposed wilderness, and wilderness inventories discussed above, we recommend that the agencies **collect and use the following GIS data layers to map areas that are unacceptable for siting geothermal projects and in siting projects to avoid impacting the identified areas:** 0-58-39

1. Designated Wilderness Areas;
2. Wilderness Study Areas;
3. National Monuments;
4. National Conservation Areas;
5. Other lands within BLM's NLCS;
6. National Historic and National Scenic Trails;
7. National Wild, Scenic, and Recreational Rivers, study rivers and segments, and eligible rivers and segments;
8. ACECs, including Outstanding Natural Areas and Research Natural Areas;
9. Forest Service Research Natural Areas;
10. Threatened, endangered and sensitive species habitat (available from USFWS[2], state wildlife agencies and, for BLM lands, from NatureServe[3]; critical cores and linkages for wildlife habitat (available from USFWS and state wildlife agencies, including in State Wildlife Action Plans, as well as the Wildlands Project and its affiliated regional organizations[4]) important bird areas (available from BLM and the National Audubon Society[5]);
11. Riparian areas (available from SWReGAP[6], except for California, which is available from the UCSB Biogeography Lab[7]); and
12. Yellowstone Controlled Groundwater Area (available from Montana's Department of Natural Resources and Conservation, 406-586-5243),

Recommendations: The agencies should complete the additional collection of data and analysis of impacts outlined above, then revise the PEIS to incorporate the results into the selected alternative.

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[2] http://www.fws.gov/southwest/es/newmexico/ES_home.cfm
[3] NatureServe was contracted to identify and map locations of threatened and endangered species habitat that exist only on BLM lands – making these areas even more critical to the survival of the species. This data can be found at www.natureserve.org

[4] http://www.twp.org/cms/page1158.cfm
[5] http://www.audubon.org/bird/IBA/
[6] http://ftp.nr.usu.edu/swgap/
[7] http://www.biogeog.ucsb.edu/projects/gap/gap_home.html

IV. Additional Analysis Is Required Prior to Leasing and Development.

The agencies have stated that this PEIS will be used to "develop a comprehensive list of stipulations, best management practices, and procedures to serve as consistent guidance for future geothermal leasing and development on public and NFS lands" and to "amend the BLM Resource Management Plans (RMPs) to adopt the resource allocations and procedures." 73 Fed.Reg. 33803. These uses require that the PEIS include sufficient environmental analysis to justify decisions and also commit the agencies to further analysis prior to approval of leasing.

A. Tiering to the PEIS must be limited and unequivocal commitments to site-specific NEPA analysis included in the PEIS and land use plan amendments.

O-58-40

The PEIS will identify lands that are available for leasing. In order to support amendment of BLM land use plans and for the Forest Service and the BLM to tier to the PEIS in connection with subsequent decision-making processes, the analysis conducted under NEPA must be sufficiently robust to support the determination that specific lands are suitable for development. NEPA requires the agencies to take a "hard look" at the potential environmental consequences of this proposed action, so that they must assess impacts and effects that include: "ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative." 40 C.F.R. § 1508.8. In the context of a programmatic EIS, "the overview or area-wide EIS would serve as a valuable and necessary analysis of the affected environment and the potential cumulative impacts of the reasonably foreseeable actions under that program or within that geographical area." Council on Environmental Quality, *Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations*, Question 24b, available at http://ceq.hss.doe.gov/nepa/regs/40/40p3.htm. For future projects, the agencies can tier to the environmental analysis in the PEIS, but this incorporation "would be followed by site-specific or project-specific EISs," which "would make each EIS of greater use and meaning to the public as the plan or program develops." *Id.*, Question 24c.

In addition, NEPA requires the consideration of a reasonable range of alternatives as part of evaluation of a proposed action. NEPA requires the agencies to "rigorously explore and objectively evaluate" a range of alternatives to proposed federal actions. *See* 40 C.F.R. §§ 1502.14(a), 1508.25(c). "An agency must look at every reasonable alternative, with the range dictated by the nature and scope of the proposed action." *Nw. Envtl. Defense Center v. Bonneville Power Admin.*, 117 F.3d 1520, 1538 (9th Cir. 1997). An agency violates NEPA by failing to "rigorously explore and objectively evaluate all reasonable alternatives" to the proposed action. *City of Tenakee Springs v. Clough*, 915 F.2d 1308, 1310 (9th Cir. 1990) (quoting 40 C.F.R. § 1502.14). This evaluation extends to considering more environmentally protective alternatives and mitigation measures. *See, e.g., Kootenai Tribe of Idaho v. Veneman*, 313 F.3d 1094,1122–23 (9th Cir. 2002) (and cases cited therein). In the context of analyzing specific leases, the range of alternatives should also include an alternative not to lease at all.

The PEIS acknowledges the need for additional environmental analysis, although it defers the level of review for individual permits to be determined at the BLM field office or FS unit and provides for that analysis to be either an EIS or a “tiered environmental assessment (EA),” depending on the extent to which “this PEIS anticipates issues and concerns associated with individual projects, including potential cumulative impacts.” Draft PEIS, p. 2-22. This statement properly acknowledges the need for site-specific analysis, but is too general.

Recommendation: Based on the general level of analysis included in the Draft PEIS, the PEIS and the subsequent amendments to BLM land use plans should specifically and unequivocally require site-specific environmental review prior to approval of projects, including opportunities for public comment and addressing direct, indirect and cumulative impacts. Both of these documents should state that an EIS will be presumed to be required unless the Forest Service or BLM determines that all site-specific concerns have been addressed in this PEIS and the cumulative impact analysis has not substantively changed. There should also be a specific commitment to considering a range of alternatives, including an alternative not to issue a lease for geothermal development.

B. Additional limitations on tiering.

The Draft PEIS acknowledges that the RFD, which forms the basis for the cumulative impact analysis, is limited, stating: 0-58-41

> The RFD was based on a review of recent government and industry reports providing assessments of geothermal potential across the western US (Western Governors’ Association 2006; DOE and BLM 2003; NREL 2006; BLM 2007a; Geothermal Energy Association 2007a) and the typical impacts associated with geothermal development (GeothermEx 2007). Few quantitative evaluations have been conducted at this scale, and those that exist are considered largely speculative due to the wide array of variables around future geothermal development. These variables include the speculative estimation of unexplored geothermal resources, the development of geothermal technologies that may allow for extraction of resources currently unusable, the unknown nature of future energy markets, and the unknown future of regulatory and political climates.

Draft PEIS, p. 2-33. Accordingly, where technologies not specifically addressed in the PEIS are proposed, their environmental consequences have not been thoroughly discussed, requiring a new assessment. Similarly, where leases are proposed in areas that were not identified in the PEIS, new analysis is required. Further, if new technologies, geographic areas or economic, regulatory or other conditions change, the cumulative impact analysis in the PEIS will no longer by accurate.

Recommendations: The PEIS should clearly state the limitations of the issues analyzed, the limitations on tiering to the PEIS for environmental analysis, and the need to update the cumulative impacts analysis if relevant factors change.

C. Best management practices must be mandated for incorporation in all permits and should not be subject to waiver, exception or modification. 0-58-42

The Draft PEIS sets out important protective terms and conditions that should be incorporated into permits. *See*, Draft PEIS, pp. 2-16 – 2-17. However, different portions of the Draft PEIS refer to these terms and conditions as those that "will" or "may" apply, giving the impression that some of these terms are required to be incorporated into permits and others may not be, even when they are applicable to a proposed location. Further, since the BLM routinely permits waiver, exception and modification of stipulations and conditions in the context of oil and gas development, there is not guarantee that these measures will be applied.

Best management practices are an important vehicle for mitigating impacts of geothermal development. However, without a definitive commitment to their use, these practices cannot be relied upon to reduce environmental consequences. *See, e.g.*, Council on Environmental Quality, *Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations*, Question 19, *Davis v. Mineta*, 302 F.3d 1104, 1125 (10th Cir. 2002).

Recommendation: The PEIS must clearly state that all best management practices, stipulations and conditions are required to be incorporated into permits where the resources that they are designed to protect are present. Further, these provisions should not be subject to waiver, exception or modification unless very narrow, specific qualifications are met and should not be available at all in the context of no surface occupancy stipulations.

D. Compliance with Section 106 of the NHPA and Section 7 of the ESA.

0-58-43

The Draft PEIS states that consultation under Section 106 of the National Historic Preservation Act and Section 7 of the Endangered Species Act will occur prior to leasing and additional consultation will occur as needed for specific projects. Draft PEIS, p. 2-21.

Recommendation: The PEIS should maintain a specific commitment to engaging in consultation prior to leasing and as needed throughout evaluation of a project.

V. The Pending Applications Should Be Assessed in Accordance with the Recommendations Set Out for New Leasing.

0-58-44

A. Pending lease applications should be subject to the screens listed in Section II prior to approval

The 19 pending lease applications should be subject to the screens listed in Section II. Any pending lease applications which conflict with the screens in Section II should either be required to alter their boundaries to avoid citizen-proposed wilderness, inventoried roadless areas, lands with wilderness characteristics and other lands with special values, or the leases should be denied.

The following lease applications encompass lands that are in Forest Service Inventoried Roadless Areas: CACA 043745, 043744, 042989 - Modoc National Forest; NVN 074289 - Humboldt-Toiyabe National Forest/Battle Mountain District; OROR 017049, 017327 - Mt. Hood National Forest; OROR 054587 - Willamette National Forest; WAOR 056025, 056058, 052069 - Mt. Baker National Forest.

The following lease applications encompass lands that are in citizen-proposed wilderness areas: CACA 043745, 043744, 042989 – Modoc National Forest/BLM Surprise Field Office; OROR 017149, 017503 – Mt. Hood National Forest/BLM Prineville Field Office.

Specific comments on individual lease applications are set out in Appendix B to these comments, attached and incorporated by reference.

Recommendation*:* If pending applications conflict with the screens in Section II, the agencies should either alter the lease boundaries to avoid the conflict or deny the application.

B. Because the pending lease applications anticipate the use of binary cycle systems, the agencies should prioritize leases in areas that are not controversial and have well-documented resources, and consider use of conditional development leases until the technology is proven to be successful 0-58-45

As discussed in previous sections of the comments, because the binary cycle technology proposed for development in the pending lease applications has not been thoroughly tested, the proposed development requires a careful, measured approach to minimize potential impacts.

Recommendation: The agencies should consider prioritizing approval of applications and use of conditional development leases until technology is proven to be successful.

We look forward to continuing to participate in this process. Please feel free to contact us if you have any questions or need additional information. We would also welcome the opportunity to meet with you to present and discuss these comments in person.

Sincerely,

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Appendix B: Comments on Specific Pending Lease Applications

El Centro Field Office (Draft PEIS, Chapter 12) O-58-46

Recommendation: Subject to the screens listed in Section II and all of the other recommendations included in these comments, this lease should be approved. This will protect the other resources of this area while still allowing development of the geothermal resource and the benefits to climate change from renewable energy development.

Modoc National Forest/Surprise Field Office (Draft PEIS, Chapter 13)

The pending lease applications have significant conflicts, overlapping nearly entirely with FS Inventoried Roadless Areas (IRAs) and Citizen Wilderness Inventory Areas (CWIAs). The pending lease applications overlap with the Powley and Soldier IRAs and the Powley Creek and Cedar Mountain CWIAs. However, the DPEIS states that development would result in two binary power plants outside of these conflict areas – one on the private lands of pending lease site CACA 043745 and one in the northwestern portion of pending lease application site CACA 043745 (DPEIS 13-8). O-58-47
The PEIS also acknowledges that there are known cultural resources in the area of the leases (and even within one of the leases), which would be "considered significant cultural resources to the local Native Americans and tribes." (PEIS, p. 13-39)

The PEIS further states that areas of potential affect such as access roads, power plants, well pads, etc., would be analyzed at the project specific level and require inventories, evaluations, and appropriate treatments as outlined in the BMPs. As detailed in Appendix D of the PEIS, this would include:

- Unexpected discovery of cultural resources stops development work and requires notice of the responsible BLM officer for evaluation and development of appropriate mitigation measures;
- Section 106 of the National Historic Preservation Act compliance before any specific permitting under the leases; and Development of a Cultural Resources Management Plan if cultural resources are identified at the site, or if areas with high potential to contain cultural materials have been identified.

Under these BMPs, BLM would also conduct Section 106 consultation with the SHPO, Native American tribes with historic ties to the area, and local historic preservation groups. Project specific impacts after leasing would be reduced by implementing these BMPs.

Recommendation: The boundaries of these pending lease applications should be redrawn to exclude the IRAs and CWIAs, or the applications should be denied. Due to the presence of significant cultural resources in the area and even within one lease boundary, it is critical that the agencies follow the BMPs set out in the PEIS to protect these resources. If the lease boundaries are redrawn to exclude IRAs and CWIAs, and subject to the screens listed in Section II and all of the other recommendations included in these comments, this lease should be approved. This will protect the other resources of this area while still allowing development of the geothermal resource and the benefits to climate change from renewable energy development.

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O-58-1

DOE and others are actively funding research to better understand the viability of recovering the heat from hot fluids from oil and gas wells (e.g., Rocky Mountain Oilfield Testing Center near Casper, Wyoming and research symposia and research at Southern Methodist University). It has been a very slow process, taking almost five years for both to get off the ground. In addition, with the publication of The Future of Geothermal Energy: Impact of Enhanced Geothermal System (EGS) in the United States by MIT in 2006, followed two years later by both the Department of Energy's recent RFP regarding further R&D on EGS, and Google Foundation's 2008 announcement of its funding of further EGS research and development, EGS development studies are ongoing. While neither BLM nor FS are research agencies, they pay very close attention to these studies.

Site-specific analysis of leases and project applications will also be necessary to address the particular impacts of future leases and projects from various technologies.

The PEIS also provides for mitigation and monitoring of leases, stipulations, and permit conditions, as discussed on page 2-20 of the Draft PEIS.

O-58-2

Please see response to comments I-2-4 and I-2-6 for a discussion of flash steam technology.

The PEIS covers geothermal leasing. Issuance of a lease does not require the lease holder to specify what kind or size of plant would be developed on the lease site; therefore, discussion of alternate technologies is not appropriate in this analysis (see Section 1.11.1 *BLM and FS Decisions to be Made Following Subsequent NEPA Analysis* for further discussion of permitting). All development and utilization and reclamation activities would be subject to further site-specific permitting and environmental analysis.

O-58-3

As noted in the comment and in the PEIS, there are similarities in the leasing process and how geothermal resources are explored, drilled, and developed. The BLM and FS have appropriately applied many of the lessons of oil and gas to the development of the proposed action, including proactive stipulations.

O-58-4

The PEIS has been modified to include additional climate change discussion for affected resources. Please see the water, soil, vegetation, fish and wildlife, and other resource sections in the Final PEIS.

O-58-5

In accordance with 40 CFR Section 1502.13, the purpose of and need for the proposed action is used to define a range of reasonable alternatives (purpose of and need for action is defined in Sections 1.2 and 1.3). The BLM is making an allocation decision here and adopting a list of stipulations, BMPs, and compliance procedures to be incorporated in the land use plans. The PEIS analyzes in detail the Proposed Action, a No Action alternative, and a Leasing Near Transmission lines alternative. The Final PEIS incorporates input from public comments on the Proposed Action. Another alternative considered but eliminated from detailed study included no leasing or development of geothermal resources on public or NFS lands (Section 2.4.1). As explained in Section 2.4.1, this alternative, which would have been the most protective (from a ground disturbance standpoint), was eliminated because it would violate the multiple use provisions of FLPMA and is inconsistent with the President's National Energy Policy, the Energy Policy Act of 2005, and Executive Order 13212 and would not have fulfilled the purpose and need for the proposed action.

The alternatives analyzed represent a range of acreages as potentially available for leasing. See CEQ's *Forty Most Asked Questions Concerning the CEQ's NEPA Regulations*, Question 1b ("When there are potentially a very large number of alternatives, only a reasonable number of examples, covering the full spectrum of alternatives, must be analyzed and compared in the EIS.") In particular, the Leasing Near Transmission Lines alternative was developed based on public scoping comments to represent a limited development alternative. Instead of inventing a variety of alternatives that would lie between the alternatives presented, the BLM and FS elected to include protective measures (i.e., stipulations, BMPs, and compliance procedures) in each of the action alternatives. Further, those planning areas whose plans include more protective measures may elect to keep those measures in place, instead of the stipulations, BMPs, and compliance procedures presented in the Final PEIS.

O-58-6

The commentor's concerns with Alternative B are noted.

See the above responses in this letter for details on level of analysis and protections provided in the PEIS.

O-58-7

The commentor's concerns with Alternative C are noted.

O-58-8

The existing case law regarding the roadless rule is inconsistent. On August 12, 2008, the Wyoming District Court found the 2001 Roadless Rule violated NEPA and the Wilderness Act (*State of Wyoming v. US Department of Agriculture,* 07-CV-17-B, Wyoming District Court, Cheyenne, Wyoming [2008]). The District Court ordered the 2001 Roadless rule "set aside" and "permanently enjoined." This order is subsequent to a 2006 California District Court ruling that set aside the 2005 State Petitions Rule and reinstated the 2001 Roadless Rule. See *California ex re. Lockyer v. US Department of Agriculture*, 459 F.Supp.2d 874 (N.D. Cal 2006). The United States Justice Department, on behalf of the Department of Agriculture, has filed motions with both the Wyoming and California courts seeking adjustments of those courts' conflicting judicial orders. Neither the Wyoming nor California District Court rulings bar the Department of Agriculture from promulgating other roadless area regulations. To address this inconsistency, the PEIS includes the following Department of Agriculture Roadless Area Stipulation, "If future legislation or regulation change the roadless area designation, the restriction would be revised along with any appropriate environmental review." An appropriate NEPA review would be required prior to any changes to the Roadless Area Stipulation.

O-58-9

Decisions regarding the management of areas with wilderness characteristics are made at the field office level as part of the local land use planning process and not in this PEIS. This allows wilderness characteristics to be evaluated at a finer scale than afforded at a programmatic level. The management and level of protection of the wilderness characteristics on non-WSA lands is discretionary and not bound by requirements of the Wilderness Act of 1964 or the WSA Interim Management Policy (IMP, H-8550-1; BLM 1995); thus, these areas have no official status that removes them from consideration for leasing. Nonetheless, the BLM must consider in its NEPA analyses possible impacts on wilderness characteristics, if present, and may manage the lands to protect and/or preserve some or all of those characteristics through the local land use planning process.

As noted in Chapter 2 of the Draft PEIS, before making any leasing decisions, the BLM will assess whether the existing NEPA is adequate (i.e., through completion of a DNA), or whether there is new information or new circumstances that warrant further analysis. For example, additional NEPA analysis may be required in light of new information, or from a potential change in management approach regarding resources identified for special management (e.g., travel management planning or areas under consideration by BLM for management for wilderness characteristics).

O-58-10

Decisions regarding the management of areas with wilderness characteristics are made at the field office level as part of the local land use planning process and not in this PEIS. This allows wilderness characteristics to be evaluated at a finer scale then can be afforded at a programmatic level. The management and level of protection of the wilderness characteristics on non-WSA lands is discretionary and not bound by requirements of the Wilderness Act of 1964 or the WSA Interim Management Policy (IMP, H-8550-1; BLM 1995); thus, these areas have no official status that removes them from consideration for leasing. Nonetheless, the BLM may manage the lands to protect and/or preserve some or all of those characteristics through the local land use planning process.

O-58-11

Thank you for your comment. The PEIS does provide BMPs and stipulations that protect important migration corridors. Language has been revised in Section 2.2.2 *Procedures Prior to Leasing* to state:

- The authorized officer of the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states manage and typically have regulatory authority for water quality, water rights, and wildlife; and

- The authorized officer of the BLM or FS would review the lands for any other sensitive resources (e.g., paleontological, BLM sensitive status species, and FS species of local concern) and provide for the necessary stipulations to protect these resources and ensure compliance with the land use plan. Assessment of the resource would include consulting with agency experts, coordinating with other appropriate agencies, and site surveys, if warranted.

Prior to any geothermal development, site-specific NEPA would be conducted and migration corridors and important wildlife habitats would be identified. Appropriate measures, including but not limited to those provided in the list of BMPs, would be applied to protect these areas.

O-58-12

The BLM and operators would work with agencies and local stakeholders to identify areas requiring protection and mitigate impacts to special designation areas. See Section 4.2.8 for discussion of areas closed to leasing by Congressional designation.

O-58-13

The purpose of Appendix A is to provide a factual overview of the current status of geothermal resources and the permitting requirements in each state. It is educational, not a proposal. Chapter 2 of the PEIS details the lands proposed for closure and the proposed stipulations for lands with sensitive resources.

O-58-14

Given that impact on geothermal resources from adjacent development may vary based on site-specific conditions, no specific buffer zone has been established for Yellowstone under the proposed action. See response to comment O-58-18 for a discussion of protection of NPS lands.

O-58-15

Given that impacts on geothermal resources from adjacent development may vary based on site-specific conditions, no specific buffer zone has been established for Yellowstone under the proposed action. See response to comment O-58-18 for a discussion of protection of NPS lands.

O-58-16

Given that impacts on geothermal resources from adjacent development may vary based on site-specific conditions, no specific buffer zone has been established for Yellowstone under the proposed action. See response to comment O-58-18 for a discussion of protection of NPS lands.

O-58-17

Given that impacts on geothermal resources from adjacent development may vary based on site-specific conditions, no specific buffer zone has been established for Yellowstone under the proposed action. See response to comment O-58-18 for a discussion of protection of NPS lands.

O-58-18

The BLM and FS are committed to working with the NPS to avoid adverse impacts to thermal features within NPS units. The language in Section 1.5.4 *Environmental Review Requirements Prior to Leasing* has been revised to clarify further that the BLM is prohibited from geothermal leasing on NPS lands as well as on lands where the Secretary has determined that geothermal operations are reasonably likely to result in a "significant adverse effect on a significant thermal feature" in a unit of the NPS. In addition, a list of the 12 units of the NPS with significant thermal features that occur in the study areas is now included.

Prior to inclusion of any specific parcels in a lease sale, the BLM and FS would coordinate with the National Park Service to determine if there would be any impacts to thermal or hydrological features within NPS units in proximity to a proposed lease. Language has been added to Section 2.2.2 *Procedures Prior to Leasing* to reiterate this point.

In addition, should development be determined to be reasonably likely to have an "adverse effect" on a significant thermal feature, the BLM would include appropriate lease stipulations to protect the park unit.

If it is determined in advance of leasing that exploration, development, or utilization of the lease parcel would "reasonably likely result in a significant adverse effect on a significant thermal feature of a National Park System unit," then the lease would not be issued (30 USC Section 1026[c]). While preexisting leases and permits are beyond the scope of this PEIS, the statute also provides that, if it is determined that use of an existing lease or permit would be "reasonably likely to adversely affect" any significant thermal feature within a National Park System unit, then stipulations are included on leases and permits to protect the thermal features (30 USC Section 1026 [d]).

O-58-19

This PEIS allocates areas as being available or closed to geothermal leasing. Stipulations have also been identified that would be applied to protect sensitive resources. Before issuing any leases, the BLM would conduct the necessary review to ensure that leasing would be compatible with the local land use plan and would comply with all applicable Federal, state, and local laws and regulations. As noted in Section 2.2.2, there are a variety of stipulations and BMPs that could be applied to address sensitive issues and conditions.

O-58-20

Please see response to comment O-58-19, above.

O-58-21

Please see response to comment O-58-19 above.

O-58-22

Please see response to comment O-58-19 above.

O-58-23

Please see response to comment O-58-19 above.

O-58-24

The PEIS covers geothermal leasing. Issuance of a lease does not require the lease holder to specify what kind or size of plant would be developed on the lease site. This document does predict a general level of anticipated future geothermal development in BLM areas that have geothermal potential and does discuss some of the available technologies, but it is not intended to provide full analysis of all phases of development. All development and utilization, including impacts of the specific technology used at plants, would be subject to further site-specific permitting and environmental analysis.

O-58-25

As stated in the above response, issuance of a lease does not require the lease holder to specify what kind or size of plant would be developed on the lease site. This document does predict a general level of anticipated future geothermal development in BLM areas that have geothermal potential and does discuss some of the available technologies, but it is not intended to provide full analysis of all phases of development. All development and utilization, including impacts of the specific technology used at plants, would be subject to further site-specific permitting and environmental analysis.

O-58-26

Please see the above response.

O-58-27

Additional discussion has been added to the cumulative impact analysis, including discussion on various ongoing transmission line projects and reasonably foreseeable transmission efforts. As noted in Chapter 5, past, present, and reasonably foreseeable actions, including commercial uses of public and federal lands, are documented and analyzed.

O-58-28

Additional text has been added to the socioeconomics sections in Chapter 3 and Chapter 4 to address non-market values.

O-58-29

Additional text has been added to the socioeconomics sections in Chapter 3 and Chapter 4 to address non-market values.

O-58-30

Additional text has been added to the socioeconomics sections in Chapter 3 and Chapter 4 to address non-market values.

O-58-31

Additional text has been added to the socioeconomics sections in Chapter 3 and Chapter 4 to address non-market values.

O-58-32

The comment is noted. No surface use stipulations for important viewsheds and BMPs for the protection of visual resources (see Appendix B) would be applied, as appropriate to land use plan revisions.

O-58-33

The BLM is proposing to include a Sensitive Species Stipulation for leases in areas that have agency-designated sensitive species. The stipulation could be a NSO, CSU, or TL in order to meet resource objectives (Page 2-19 of the Draft PEIS). This approach provides the flexibility to respond to the dynamic national and regional planning and protection efforts for these species. During the permitting process for any subsequent drilling or development applications, the BLM would conduct the appropriate analysis on siting locations, as noted in the comment.

To provide further protection for threatened, endangered, and sensitive species, the BLM will impose an Endangered Species Act stipulation (see Section 2.2.2) on all geothermal leases.

O-58-34

Thank you for your comment. Unfortunately, this level of data analysis is beyond the scope of the PEIS. The analysis in Chapter 4 is commensurate with the scope of the proposed action for the PEIS.

O-58-35

Decisions regarding the management of areas with wilderness characteristics are made at the field office level as part of the local land use planning process and not in this PEIS. This allows wilderness characteristics to be evaluated at a finer scale than afforded at a programmatic level. The management and level of protection of the wilderness characteristics on non-WSA lands is discretionary and not bound by requirements of the Wilderness Act of 1964 or the WSA Interim Management Policy (IMP, H-8550-1; BLM 1995); thus, these areas have no official status that removes them from consideration for leasing. Nonetheless, the BLM must consider in its NEPA analyses possible impacts on wilderness characteristics, if present, and may manage the lands to protect and/or preserve some or all of those characteristics through the local land use planning process.

As noted in Chapter 2 of the Draft PEIS, before making any leasing decisions, the BLM will assess whether the existing NEPA documentation is adequate (i.e., through completion of a DNA), or whether there is new information or new circumstances that warrant further analysis. For example, additional NEPA analysis may be required in light of new information, or from a potential change in management approach regarding resources identified for special management (e.g., travel management planning or areas under consideration by BLM for management for wilderness characteristics).

Please see the response to comment O-58-8 regarding roadless area regulations.

O-58-36

As stated in PEIS Section 2.2.2 *Procedures Prior to Leasing*, the authorized officer for the BLM or FS will consult with Native American Tribal governments, Alaska Natives, and State Historic Preservation Officers. Through consultation, the agencies would identify tribal interests and traditional cultural resources or properties that may be affected by the federal leases and potential geothermal energy development and the presence of archaeological sites and historic properties per Section 106 of the National Historic Preservation Act.

The programmatic EIS does not change existing closures, avoidance or protective measures developed for cultural resources, or tribal concerns. It does not constrain local FS or BLM offices from determining new restrictions or closures in land use plans or through special designations. It does describe a process to ensure that these concerns are addressed through tribal consultation at each phase of leasing and development.

O-58-37

The PEIS was based on the best available GIS data available and appropriate for the analysis, including from data sets used in the West-wide Energy Corridors Draft PEIS. The scope of the GIS data is discussed in Section 1.9.3 *Scope of GIS Data and Graphics of the Draft PEIS*.

While the BLM used the GIS data for programmatic level analysis, it is not necessarily appropriate for site-specific analysis. Maps from the Final PEIS will be provided on the public project website.

O-58-38

Available GIS data for the criteria listed in the Proposed Action (Section 2.1.1 *Identify Lands for Leasing*) were used for analysis, data calculations, and graphics.

O-58-39

Figures and acre calculations were developed using GIS for the criteria outlined in the Proposed Action (Section 2.1.1 *Identify Lands for Leasing*). As noted in this section, it included many of the layers listed in the comment. Other layers, including habitat data, watersheds, and soils, were used in preparing the affected environment sections and for the impact analysis.

O-58-40

Prior to making leasing decisions, BLM will assess whether the existing NEPA documentation is adequate (i.e., through completion of a DNA), or whether there is new information or new circumstances that warrant further analysis. As stated in the above responses, all development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis. This document does predict a general level of anticipated future geothermal development in BLM areas that have geothermal potential, but it is not intended to provide full analysis of all phases of development. There are several subsequent stages of decision making necessary to approve geothermal resource development, each with its own environmental compliance requirements, including public involvement, as applicable. This document covers only the land use planning and lease issuance stages.

O-58-41

Because it is difficult or even impossible to foresee all future permutations of possible geothermal development, the BLM could not create an exhaustive list of the limitations on the future use of this PEIS. Rather, as stated in the Draft PEIS, prior to making leasing decisions the BLM would asses whether the existing NEPA documentation is adequate (through completion of a DNA) or whether there is new information or new circumstances that warrant further analysis (see Section 2.2.2 *Procedures Prior to Leasing*).

O-58-42

It is important to clarify that stipulations are applied to leases, while BMPs are optional actions that can be applied to subsequent development permits based on local site conditions. As noted in Chapter 2 of the Draft PEIS, the stipulations provided in the PEIS would serve as the minimal level of protection and would be adopted into local land use plans upon signing of the ROD. If existing land use plans offer more protective measures or have resource-specific commitments, those more protective measures would apply instead. Section 2.2.2, subsection *Lease Exceptions, Waivers, and Modifications* discusses the limited circumstances under which lease stipulations can be excepted, waived, or modified.

O-58-43

As stated in PEIS Section 2.2.2 *Procedures Prior to Leasing*, the authorized officer for the BLM or FS will consult with Native American Tribal governments, Alaska Natives, and State Historic Preservation Officers. Through consultation, the agencies would identify tribal interests and traditional cultural resources or properties that may be affected by the federal leases and potential geothermal energy development and the presence of archaeological sites and historic properties per Section 106 of the National Historic Preservation Act.

O-58-44

The comment for suggested revision of lease boundaries has been noted.

The authorized officer always retains the discretion to reject geothermal lease applications or lease parcels prior to issuance or sale, respectively.

Stipulations have also been identified that would be applied to protect sensitive resources. Before issuing any leases, the BLM would conduct the necessary review to ensure that leasing would be compatible with the local land use plan and would comply with all applicable Federal, state, and local laws and regulations. As noted in Section 2.2.2, there are a variety of stipulations and BMPs that could be applied to protect sensitive issues and conditions.

Please see response to comment O-58-8 above for discussion of roadless area regulations.

O-58-45

The PEIS covers geothermal leasing. Issuance of a lease does not require the lease holder to specify what kind or size of plant would be developed on the lease site; therefore, discussion of alternate technologies is not appropriate in this analysis (see Section 1.11.1 *BLM and FS Decisions to be Made Following Subsequent NEPA Analysis* for further discussion of permitting). All development and utilization and reclamation activities would be subject to further site-specific permitting and environmental analysis.

O-58-46

The conditional support for issuance of the El Centro leases has been noted.

O-58-47

The comment for suggested revision of lease boundaries has been noted and will be considered by the FS and BLM prior to leasing decisions.

UINTAH COUNTY

STATE OF UTAH

Our past is the nation's future

COMMISSIONERS:
Michael J. McKee
David J. Haslem
Darlene R. Burns
ASSESSOR - Rolene Rasmussen
ATTORNEY - JoAnn B. Stringham
CLERK-AUDITOR - Michael W. Wilkins
RECORDER - Randy J. Simmons
TREASURER - Wendy Long
SHERIFF - Jeff Merrell
SURVEYOR - John Slaugh

September 19, 2008

Geothermal Programmatic EIS
c/o EMOSi
182 Howard Street, Suite 110
San Francisco, CA 94105-1611

RE: Draft Programmatic EIS for leasing of Geothermal Resources in 11 Western States and Alaska

Dear Sirs:

Thank you for the opportunity to comment on the Draft Programmatic EIS (DPEIS) for Leasing of Geothermal Resources.

Our comments are below:

The DPEIS addresses incorporation of the findings into existing Resource Management Plans (RMP's) and lists the plans that will be amended when the EIS (Environmental Impact Statement) is implemented. The DPEIS does not state clearly how it will be incorporated with respect to RMP's that are in draft stages. A-59-1

A number of the RMP's listed to be revised are likely to be in the final stages of approval or approved prior to the implementation of the EIS.

It is possible that the Diamond Mountain Plan and Book Cliffs Plan will be replaced by the Vernal Office Resource Management Plan by the time the decision is released.

Uintah County is concerned that geothermal leasing decisions may be diluted or rejected in the RMP revision process that incorporates them into the RMP because of proposed or existing resource allocations.

Language should be developed to guide such incorporation. In particular, decisions in the RMP's, such as ACEC's (Areas of Critical Environment Concern) and non-WSA (Wilderness Study Areas) lands with wilderness characteristics or unavailable for leasing, which would prevent geothermal leasing, should be re-analyzed unless the impacts to geothermal resources were analyzed and disclosed in the RMP/EIS

Thank you for your attention to these comments.

Sincerely,

UINTAH COUNTY COMMISSION

Michael J. McKee | Darlene R. Burns

Michael J. McKee, Chairman | David J. Haslem | Darlene R. Burns

A-59-1

The geothermal RMP amendments would amend the Book Cliffs and Diamond Mountain plans. Once the ROD is signed for the Vernal RMP revision, it will become the guiding management document. The potential for geothermal development in Vernal is limited enough so that future site-specific analysis is anticipated to be sufficient to support the development.

IDAHO WILDLIFE FEDERATION
Affiliated with the National Wildlife Federation

Geothermal Programmatic EIS
C/O EMPSi
182 Howard Street, Suite 110
San Francisco, CA 94105-1611

September 19, 2008

RE: Draft Programmatic Environmental Impact Statement
For Geothermal Leasing in the Western United States

The Idaho Wildlife Federation has reviewed the Bureau of Land Management, and U.S. Forest Service, *Draft Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States, including Alaska*. This draft PEIS has set forth three alternatives with respect to future action taken regarding the development of BLM and U.S. Forest Service lands to geothermal leasing. Upon review of the draft PEIS, the Idaho Wildlife Federation is going on record in support of Alternative A, which is the No Action Alternative. O-60-1

Sincerely,

Robert B Fraser

Rob Fraser
Director – Idaho Wildlife Federation

PO Box 6426, Boise, ID 83707 Phone: 208-342-7055 Fax: 208-342-2366
idahowildlife@gmail.com www.idahowildlife.org

O-60-1

The commentor’s support for Alternative A is noted.

Pit River Tribe Environmental Department

37118 Main Street • Burney, CA 96013
phone 530.335.5062 • fax 530.335.5069 • email *shastamedicine@snowcrest.net*

September 18, 2008

via electronic mail (geothermal_EIS@blm.gov)

Geothermal Programmatic EIS
c/o EMPSi
82 Howard Street, Suite 110
San Francisco, California 94105

Re: Comments on the Draft Programmatic Environmental Impact Statement for Geothermal Energy Leasing

Dear Sir or Madam:

The Pit River Tribe Environmental Department submits the following comments containing grave concerns about the Draft Programmatic Environmental Impact Statement for Geothermal Energy Leasing (PEIS), affecting sacred lands that are vital to the Tribe's spiritual, cultural, and physical wellbeing.

The Pit River Tribe is a federally recognized sovereign Indian Tribe consisting of eleven autonomous bands. Members of the Pit River Tribe have used, and continue to use, Mount Shasta, the Medicine Lake and the Highlands, and the Warner Mountains for religious and cultural purposes. These areas, and possibly others within the PEIS boundaries, are vital to the spiritual and cultural continuity of the Pit River Nation.

The Tribe's federally approved Tribal Constitution grants the Tribe the authority to "exercise its jurisdiction to the fullest extent permitted by Federal Law, including but not limited to, lands, waters, properties, air space, fish and wildlife and other resources" on its ancestral lands.[1]

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[1] PIT RIVER TRIBE CONSTITUTION.

Request to submit additional comments

The Tribe requests an extension of the comment deadline pending complete consultations regarding the PEIS. While initial consultations were recently held, the Tribe does not consider that it has been given a full picture of the implications of the PEIS for its interests. The Tribe may wish to add concerns other than those stated in this letter, based on information newly made available to the Tribe at a recent quarterly meeting with the Modoc National Forest and during further consultations. A-61-1

Areas of critical spiritual, cultural and physical importance to the Pit River Tribe

We are aware that three areas, included in Table 2-7 [page 2-35 of the PEIS] and in the Lease Applications, are of vital significance to the Tribe. These areas are the Medicine Lake Highlands in the Modoc and Klamath National Forests, Mount Shasta in the Shasta-Trinity National Forests, and areas in the Warner Mountains within the Modoc National Forest. A-61-2

Table 2-7 [PEIS at 2-35] shows that the Medicine Lake/Glass Mountain area has a projected capacity of 480 megawatts, and that Mount Shasta could produce up to 240 megawatts. These figures are totally unsubstantiated by any exploration projects, which were either a total failure or, at best, marginal. We believe these highly exaggerated figures to be a fabrication of geothermal companies (Calpine and Vulcan) who are seeking to mislead the agencies in order to prioritize these areas for geothermal leasing.

The projected 480 megawatts adds up to ten power plants in the Medicine Lake Highlands, for a total of at least 60-80 square miles. This would essentially mean full industrialization of the Highlands, which is wholly unacceptable to the Tribe.

For Mount Shasta, the projected 240 megawatts would mean 5 power plants, which is equally inconceivable from a Tribal point of view.

Medicine Lake Highlands

A-61-3

The Medicine Lake volcanic caldera and surrounding forested Highlands form a unique, visually stunning landscape that has been revered by the region's Indian Tribes and used in Native American cultural and religious ceremonies "since time immemorial," or for at least 10,000 years by the archaeologist's count. The Tribe has long used, and continues to use the Medicine Lake Highlands for religious and cultural purposes, including vision quests, religious prayers and teaching, traditional shaman/doctoring practices, life cycle ceremonies, the collection of traditional foods, medicines and materials, quiet contemplation, and spiritual renewal.[2] The Medicine Lake Caldera and Highlands have been designated as eligible for listing on the National Register of Historic Places based on the area's value to the Pit River, Modoc and other Tribes near and far. The Traditional Cultural District comprises an area of 113 square miles, encompassing the area above the 6,000 foot elevation.

Pit River people continue to depend upon the physical, environmental and visual integrity of these lands and their quietude, for carrying out these traditional practices. "This area is of utmost importance to the cultural survival of the Pit River Tribe, because it is still being utilized and still has spiritual integrity …. Whatever happens to the Medicine Lake Highlands affects our spiritual and physical existence."[3]

The Highland's enduring role in Pit River religious life is rooted in its sacred geography:

> Among all the places lying within the traditional territory of the Pit River people, few are of such *enduring cultural significance* as the Highlands . . . [it] is referred to as 'where all the water comes from,' . . . it is viewed as an integral part of Mount Shasta, called Yet, or 'sacred mountain[,]' . . . one of the primary peaks from which the world was said to have been created in Pit River oral tradition.[4]

Heritage use of the Medicine Lake Highlands continues to this day. In a decision resulting in the invalidation of Calpine's geothermal leases at Fourmile Hill within the Highlands, the Ninth Circuit Court of Appeals summed up the Pit River Tribe's continuing relationship with the Highlands:

> Medicine Lake and the highlands surrounding it are of great spiritual significance to the Pit River Tribe and to the other Native American tribes in the region . . . the highlands are within the Pit River Tribe's ancestral homelands . . . Tribe members [] consider the region sacred and continue to use numerous important spiritual and cultural sites within the Highlands.[5]

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[2] *See generally,* FOURMILE HILL GEOTHERMAL DEVELOPMENT PROJECT, VOLUME I: FINAL EIS/EIR, 3-69 – 3-71 (Sept. 1998) [hereinafter FINAL EIS/EIR] (noting that the Pit River people "were intimately and spiritually involved in their physical environment, and the landscape of their territory played an intricate role in their history, mythology, cultural patterns, and social system to the present")).

[3] Theodore Ruben Martinez & Floyd J. Buckskin, *Individual Declarations Regarding the Medicine Lake Highlands and Impacts of Proposed Geothermal Developments* at 1 (Feb. 2, 1999) [hereinafter *Martinez and Buckskin Declarations*].

[4] HISTORIC PROPERTIES MANAGEMENT PLAN FOR THE MEDICINE LAKE HIGHLANDS, at 20 (emphasis added).

[5] *Pit River Tribe v. U.S. Forest Serv.*, 469 F.3d 768, 772 (9th Cir. 2006).

In summary, the Highlands' religious and cultural significance derives from and depends fundamentally upon the physical, environmental, and visual integrity of the landscape as a whole, and upon its quietude.[6] This is acknowledged by the Modoc Forest Plan, which states that:

> The certainty and uncertainty of maintaining the group's way of life and their traditional uses of the land is *directly related to the amount of environmental disturbance* caused by Forest activities: the greater the disturbance, the more likely an area of religious or cultural significance will be changed.[7]

The need for protective action in the Medicine Lake Highlands is, therefore, readily apparent.

Mount Shasta

We have gone into detail to describe the importance of the Medicine Lake Highlands, and Mount Shasta is no less significant. Indeed, the two landscapes are linked in the Tribe's creation stories, as well as in its spiritual and cultural practices. Mount Shasta is a pinnacle of sacredness to all five Tribes of the region, as shown by an extensive ethnographic study done in conjunction with a ski resort proposal, which was denied in 1998 after a ten-year administrative and legal challenge. C-61-4

The Forest Service has decided not to consent to geothermal leasing on Mount Shasta, after consultations with the Pit River Tribe and other affected Tribes. The Forest Supervisor determined that leasing would be inconsistent with the Forest Plan because of "the risk of adverse impacts to cultural and historic values" on Mount Shasta, an "iconic landmark known world-wide for its beauty and spiritual significance." The Forest Plan directed in 1995 that Mount Shasta would be managed for "cultural and historic values, recreation and visual quality." The decision concluded that "geothermal development…would in fact be a significant degradation of a pace held sacred by many Native American peoples."

The Forest Service report emphasized that "the entire Mountain, from the peak to the surrounding flatlands, is of significance…. Repeated communications over the years document the interconnected nature of features on Mount Shasta. Tribal consultations clearly demonstrate that Mount Shasta, in its entirety, continues to be held as a sacred entity …. As was found with the geothermal developments at Medicine Lake, I believe there is no way to proceed with

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[6] *See, e.g.*, FINAL EIS/EIR at 3 – 73-76.

[7] USDA FOREST SERVICE, MODOC NATIONAL FOREST, LAND AND RESOURCES MANAGEMENT PLAN, 3-4 (1991) (emphasis added) [hereinafter MODOC FOREST PLAN].

geothermal development on Mount Shasta in a manner that does not damage fundamental cultural values."

The Regional Forester agreed with the Shasta-Trinity Supervisor, citing authorities under Sacred Sites Executive Order 13007 that directs agencies to "avoid adversely affecting the physical integrity" of Indian Sacred Sites.

Warner Mountains

The Tribe was recently made aware of the inclusion of an area of the Warner Mountains for leasing through the PEIS. This area is significant to several Tribal bands and to the Tribe as a whole. Before such an area can be considered for leasing, ethnographic and archaeological studies must be done. No irretrievable commitments can take place unless full evaluations under Section 106 of the National Historic Preservation Act are carried out. C-61-5

Other areas

Other areas of significance may exist about which the Tribe was not consulted. The Tribe requests such consultations before any area within its Traditional Ancestral Lands is included in the PEIS or any other proposal. C-61-6

Industrial geothermal development is incompatible with sacred areas

Based on our experience in the Medicine Lake Highlands, we know geothermal development to consist of a sprawling industrial production complex dominated by towering emission plumes, continuous industrial noise and lighting, and hundreds of miles of electrical lines, piping, fencing, and roads. C-61-7

Ground disturbance and landscape fragmentation is vastly understated in the PEIS [at 2-12]. The project proposals with which we are familiar would cover areas of 6 to 8 square miles *each*, with the impacts described above.

Excavation of potential wells often require a process known as Enhanced Geothermal Systems (EGS), which entails injecting large quantities of toxic acids into the ground in order to produce a pooling of the geothermal resource.

From a Tribal cultural preservation standpoint, geothermal development is one of the most harmful forms of development.[8] Geothermal plant operations are noisy and well-lit, attributes that are "fundamentally incompatible with the solace and isolation required for the vision quest.[9]

Concerns about hydrology and water quality

One of the Tribe's most valuable and important Tribal resources is water, and Medicine Lake and its surrounding springs are "a vital traditional resource for the health and well-being of the people."[10] The waters of the Medicine Lake Highlands are a key component of religious and ceremonial life for the Pit River Tribe. "Water quality is of critical concern because it impacts so many areas of life. To the Pit River Tribe, water fulfills an essential role beyond daily use." [11] The Tribe developed formal Water Quality Standards to be used as guidance supplements to the Historic Properties Management Plan for the Medicine Lake Highlands. A-61-8

The waters of the Medicine Lake Highlands also play an important role as a regional reservoir of fresh water "through recharge of snowmelt on the slopes of the Medicine Lake Volcano. [12] Due to the porous geologic environment of the Highlands, which includes a network of underground ice caves "and other cavities that are open to winter cold air," a water reservoir is collected by means of underground ice, which "may contain as much as 30 to 40 years of accumulated snowmelt in a shallow surface 'aquifer.'" [13] This reservoir steadily feeds the Fall River Springs, the Pit River, and ultimately the Sacramento River, and "supports an important sustainable fish and wildlife resource." [14]

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8 *Deur Ethnographic Study* at 94 ("The sights and sounds of geothermal plant operations . . . were fundamentally incompatible with the solace and isolation required for the vision quest. The impacts of geothermal development are therefore said to be greater than other types of development that already exist in the Highlands, and even limited geothermal development has the potential to adversely affect the broadly distributed ceremonial sites of the Highlands").

9 *Ibid.*

10 PIT RIVER TRIBE, *Tribal Water Quality Standards* at 6 [hereinafter *Water Standards*], which were incorporated into the Historic Properties Management Plan for the Medicine Lake Highlands. The Water Quality Standards were prepared with the assistance of Dr. Robert Curry, Ph.D., P.G. of Watershed Systems.

11 *Theodoratus Ethnographic Report* at 30.

12 *Water Standards* at 6.

13 *Id.*

14 *Id.*

The Tribal Standards seek "to protect and maintain the existing physical, biological, and chemical integrity" of local waters through an "anti-degradation policy" expressly akin to that which underlies the Clean Water Act.[15] The Tribal Standards provide "action limits" for evaluating water quality on the basis of a) general water quality indicators, including, *inter alia,* temperature, dissolved oxygen, pH, and turbidity, and b) chemical constituents including, *inter alia,* nitrates, sulfites, and heavy metals.[16]

Geothermal excavation and development may result in the seepage of sulfur and other pollutants into lakes, springs, and fresh water reservoirs in the Highlands. In addition to impacting the continuation of tribal rituals using Medicine Lake, Pit River Tribal members reasonably believe these areas of seepage "could ruin habitat [,] affect groundwater and kill plant life."[17]

Geothermal energy production would also likely result in over-consumption of Highland waters; this effect threatens tribal rituals and the surrounding ecosystem. A goal of the Tribe is to insure that precipitation in the Highlands continues to recharge groundwater, and to feed lakes, rivers, and springs such that there are "no changes in static groundwater levels or volumes of flow in aquifer units."[18] Changes in water flow of this sort would harm the soil moisture levels necessary to support traditional vegetation and animals, and would "occur to the detriment of traditional uses."[19] A-61-9

Air quality

A-61-10

The value of a "pure, untainted airshed" is stated by the Tribe to be a basic "[t]ribal cultural value." [20] Effective air quality management directives should include "measurable criteria, quantifiable thresholds, and clear implementation and monitoring procedures" for both a) ambient air quality and b) emissions.[21]

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[15] *Water Standards* at 1; Clean Water Act of 1977, 33 U.S.C. §1313 (d)(4)(B) ("… any water quality standard … or any other permitting standard may be revised only if such revision is *subject to and consistent with the antidegradation policy established under this section.*").
[16] *Water Standards* at 4.
[17] *Theodoratus Ethnographic Report* at 30.
[18] *Water Standards* at 8
[19] *Id.* Of particular concern to tribal members is reduced water flow from Schonchin Spring and Paynes Spring.
[20] PIT RIVER TRIBE, *Tribal Air Quality Standards for the Medicine Lake Highlands,* 1 [hereinafter *Air Standards*]. *See* Appendix C.
[21] *Id.* at 3 (stating that the Cultural Plan noticeably lacks these essential elements).

To these ends, the Tribe recommends: 1) applying federal Class I Airshed criteria to the Medicine Lake Highlands as a whole, 2) pursuing EPA Class I Airshed designation and expanding the Lava Beds Class I Airshed into the Highlands, 3) avoiding siting industrial activities within the Traditional Cultural District or Buffer Area, and 4) rerouting industrial traffic outside of the Traditional Cultural District.[22]

The visual environment

Many Pit River rituals, such as vision quests, depend upon a viewshed undisrupted by "intrusive objects" foreign to the natural environment, in order for the practioner to attain goals such as power achievement. [23] C-61-11

A successful vision quest is "dependent on an individual's ability to 'see the land the way the Creator created it.' The 'natural' landscape must therefore be experienced without noticeable evidence of human encroachment or modification."[24] Particularly in ceremonial areas, "there should be no visible scars."[25]

The ability to maintain an unimpeded view of certain landscape features, including Mount Shasta, Tule Lake, Lassen Peak, and the major butte "alignments," is of particular concern for certain rituals.[26] These landscape features "must be in clear view if tribal members are going to engage, or draw from the power of those distant places, or if the powers and moral lessons associated with those places are going to be accessible."[27]

Noise

C-61-12

Noise pollution is also deeply problematic for the Tribe. The continuation of cultural practices such as prayer, healing, and vision quests "depend[s] upon preserving natural quiet in [the Medicine Lake Highlands] area that is being threatened with increased recreational use and industrial projects."[28]

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[22] *Id.* at 4.
[23] *Id.* at 34.
[24] *Deur Ethnograhic Study* at 87.
[25] *Id.*
[26] *Id.* at 89.
[27] *Id.*
[28] PIT RIVER TRIBE, *Tribal Auditory Standards for the Medicine Lake Highland*s, 1 (Aug. 3, 2007) [hereinafter *Auditory Standards*]. *See* Appendix D.

Of particular concern to the Tribe is the finding that "noise-producing projects would be more intrusive than previously suspected," due to significant inaccuracies in noise measurements disclosed in geothermal development environmental documents.[29] These documents show noise levels in the Highlands that are far higher—by at least ten decibels—than is actually the case, erroneously minimizing the auditory impacts of geothermal operations.[30] Furthermore, noise simulation testing conducted by the Tribes has demonstrated that "existing noise standards provide inadequate protection for cultural practices even if agencies were to enforce those standards."[31]

Therefore, the Tribal Standards recommend quieter noise limits than existing agency standards provide, specifically limiting "non-natural noise" to "at most 5 dBA L_{eq} above baseline levels in the Highlands with an upper limit of 40 dBA L_{eq}."[32]

Conclusion

In summary, the Pit River Tribe requests additional consultations regarding the PEIS and its effects on lands within the Tribe's Ancestral Territory. Based on these consultations, the Tribe may wish to submit additional comments. A-61-13

At the very least, the Medicine Lake Highlands, Mount Shasta, and the Warner Mountains must be pronounced off-limits to geothermal leasing. Any leasing within these areas would be highly controversial, as Medicine Lake has already been (resulting in a 10-year legal battle). Such leasing would have unacceptable adverse effects on Tribal spiritual and cultural values and would threaten the very continuity of traditional Tribal identity. A-61-14

[29] *Id.*
[30] *Id.*
[31] *Id.*
[32] *Id.*

For other areas, the PEIS should, where appropriate, facilitate geothermal leases on a *provisional* level, until full site-specific studies (cultural, hydrologic, air, noise, wildlife and botanical, etc.) are accomplished, so as not to commit resources irretrievably before the full NEPA and NHPA processes are completed. This would avoid a situation that occurred in connection with the Telephone Flat project in the Medicine Lake Highlands. The Forest Service and BLM originally denied this project based on the new information it had obtained about the extent and significance of Tribal cultural resources and adverse impacts on these values. However, Calpine Corporation threatened a $100 million takings claim because of the rights it had been given in the leases. The original decision to deny the project was subsequently reversed, and the situation is currently in the courts. A-61-15

In other words, the agencies should reserve a way out of the lease in the event that significant resources and/or adverse effects are discovered. The environmental analysis in the PEIS is far too brief and general to take the place of full NEPA/NHPA processes, and only after these are completed on a site-specific basis would decision makers have the sound understanding to make valid decisions.

Further, the PEIS should expand the criteria for places that are off-limits to geothermal leasing. These exclusions should include Indian Sacred Sites, lands with significant water resources, and other controversial areas. A-61-16

And finally, the scope of the PEIS is far too broad in opening 192 million acres to geothermal leasing, which represents 77% of the Forest Service and BLM lands in the 12 states it covers. It is a mistake to prioritize geothermal development at the expense of other values, and it would be wiser to consider a phased approach, starting on a smaller scale with lands that are not controversial. A-61-17

Thank you for your consideration of these comments, and for your response in addressing these concerns.

Very truly yours,

Michelle Berditschevsky
Environmental Coordinator

cc: Pit River Tribal Council
Klamath Tribes
Deborah Sivas, Esq., Stanford Environmental Law Clinic
Native Coalition for Medicine Lake Highlands Defense
Mount Shasta Bioregional Ecology Center
Save Medicine Lake Coalition

A-61-1

The government will continue to consult with the Pit River Tribe and will address any comments.

A-61-2

The RFD scenario was developed based on the Western Governors Association 2006 report and BLM data. The potential development scenario is based on the current best available information and may change if new information becomes available. Development at any site will require additional NEPA evaluation to address site-specific resource values and analyze potential impacts.

A-61-3

As described in Section 2.2.2 *Procedures Prior to Leasing*, prior to inclusion of a lease in a competitive bidding process, the BLM or FS would review the lease area for sensitive resources and would provide the necessary stipulations to protect these resources. This review would include consultation with appropriate Native American Tribal Governments as necessary.

A-61-4

The Forest Service is engaged in consultation with the Pit River Tribe, and these points will be addressed in consultation prior to a decision being made.

A-61-5

As stated in PEIS Section 2.2.2 *Procedures Prior to Leasing*, the authorized officer for the BLM or FS will consult with Native American Tribal governments, Alaska Natives, and State Historic Preservation Officers. Through consultation, the agencies would identify tribal interests and traditional cultural resources or properties that may be affected by the federal leases and potential geothermal energy development and the presence of archaeological sites and historic properties per Section 106 of the National Historic Preservation Act.

A-61-6

As stated above, the BLM or FS will consult with Native American Tribal governments, Alaska Natives, and State Historic Preservation Officers prior to leasing.

A-61-7

All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis. This document does predict a general level of anticipated future geothermal development in BLM areas that have geothermal potential, but it is not intended to provide full analysis of all phases of development. There are several subsequent stages of decision making necessary to approve geothermal resource development, each with its own environmental compliance requirements, including public involvement, as applicable. This document covers only the land use planning and lease issuance stages.

A-61-8

Appendix D provides BMPs to address methods to minimize groundwater contamination. Federal, state, and local regulations ensure that operators will conduct drilling in a prudent manner. Potential for contamination based on local soil types and groundwater conditions would be assessed prior to issuance of permits for development.

As stated in PEIS Section 2.2.2 *Procedures Prior to Leasing*, the authorized officer for the BLM or FS will consult with Native American Tribal governments prior to leasing. Through consultation, the agencies would identify tribal interests and traditional cultural resources or properties that may be affected by the federal leases.

A-61-9

Prior to leasing, the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states typically manage and have regulatory authority for water quality, water rights, and wildlife. Consultation with local tribal agencies is also required prior to leasing. Site-specific impacts on water resources, including groundwater and water importation, would be addressed as part of the environmental analysis for the permitting process. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis, including public involvement, as appropriate. The BLM and FS would work with interested and affected parties to identify and resolve resource conflicts. Appropriate site-specific mitigation would be developed as necessary.

A-61-10

The Tribe's cultural value for pure, untainted airshed has been added to the Tribal Interests affected environment section. As noted in the impact analysis, any subsequent development could have this type of impact. The FS has ongoing consultation with the tribe to discuss this and all tribal concerns.

A-61-11

As stated in PEIS Section 2.2.2 *Procedures Prior to Leasing*, the authorized officer for the BLM or FS will consult with Native American Tribal governments. Through consultation, the agencies would identify tribal interests, such as the specific visual resource concerns discussed in this comment.

A-61-12

As stated in PEIS Section 2.2.2 *Procedures Prior to Leasing*, the authorized officer for the BLM or FS will consult with Native American Tribal governments. Through consultation, the agencies would identify tribal interests, such as the tribal noise standards discussed in this comment.

A-61-13

The government will continue to consult with the Pit River Tribe and address any comments.

A-61-14

As described in Section 2.2.2 *Procedures Prior to Leasing*, prior to inclusion of a lease in a competitive bidding process, the BLM or FS would review the lease area for sensitive resources and would provide the necessary stipulations to protect these resources. This review would include consultation with appropriate Native American Tribal Governments, as necessary.

A-61-15

As noted in Chapter 2, Procedures Prior to Leasing, the BLM or FS would consult with the appropriate Native American Tribes and SHPO in accordance with Section 106 of the National Historical Preservation Act prior to issuing any leases in order to address cultural concerns. Since the case study cited in the comment, the BLM has adopted two new stipulations that are applied to all leases notifying lease holders that the BLM may not approve ground-disturbing activities that may affect resources protected by cultural resource laws, statutes, or orders. These stipulations are included in the Proposed Action in Chapter 2.

A-61-16

This PEIS allocates areas as being available or closed to geothermal leasing. Stipulations have also been identified that would be applied to protect sensitive resources. Before issuing any leases, the BLM would conduct the necessary review to ensure that leasing would be compatible with the local land use plan and would comply with all applicable Federal, state, and local laws and regulations. As noted in Section 2.2.2, there are a variety of stipulations and BMPs that could be applied to protect sensitive issues and conditions.

A-61-17

By opening lands to geothermal leasing, the BLM and FS are not giving geothermal development a higher priority than other land values. The authorized officer always retains the discretion to reject geothermal lease applications or lease parcels prior to issuance or sale, respectively.

All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis. This document does predict a general level of anticipated future geothermal development in BLM areas that have geothermal potential, but it is not intended to provide full analysis of all phases of development. There are several subsequent stages of decision making necessary to approve geothermal resource development, each with its own environmental compliance requirements, including public involvement, as applicable. This document covers only the land use planning and lease issuance stages.

geothermal_eis

From: Mary_Christensen@blm.gov [Mary_Christensen@blm.gov] **Sent:** Fri 9/19/2008 8:59 PM
To: geothermal_eis
Cc:
Subject: Mail forwarded from geothermal_eis@blm.gov
Attachments:

This message has been automatically forwarded from geothermal_eis@blm.gov.

Carolyn Jones Weinberger <carolynweinberger@comcast.net>
09/19/2008 09:53 PM

To: Geothermal PEIS <geothermal_EIS@BLM.gov>
cc:
bcc:
Subject: PEIS Comments

To BLM
Re: Comments on proposed geothermal PEIS

The proposed PEIS is a disaster for the American Public. It vitiates the protections of NEPA & CEQA by granting a blanket ok for geothermal leasing projects without considering site specific detriments. Nowhere are the REAL impacts of geothermal development considered under the PEIS!! Issuance of leases before REAL impacts are considered is a giveaway of lands with recreational, cultural, scenic, wildlife habitat value without even evaluating these factors let alone the impacts on air, and water quality, ESPECIALLY SINCE ONCE THE LEASE IS ISSUED IT CANNOT BE CHALLENGED. At least that is the position of the government and companies granted leases under similar conditions a decade or more ago. C-62-1

Geothermal is not per se "green' energy. Rather it is like extracting oil in its impact on the environment. Huge power plant/ cooling tower complex, many clear cut well pads, decades of 24 hour lighting and noisy diesel-powered drill rigs as well as pipelines, and transmission corridors are among the well documented impacts on water, air and other landscape-fragmenting, habitat destroying consequences. C-62-2

The PEIS doesn't disclose the immense problems encountered through a similar leasing process in areas such as the Medicine Lake Highland, Newberry Crater and Cosco Hot Springs. It fails to adequately analyze 19 lease applications pending prior to 2005. To meet NEPA requirements the PEIS must contain language that allows a project to be denied based on site specific conditions disclosed through the NEPA and CEQA processes. Also, the criteria for closing land to geothermal development are too restrictive. They must include headwater sources, sensitive Native American cultural areas, scenic lands used primarily for recreation and lands containing fragile environment resources and wildlife habitat. In particular re California-the Medicine Lake Highlands and Mount Shasta must be excluded from geothermal leasing. C-62-3

It's high time the BLM acted in the interests of all the people who value and want our public lands protected rather than the despoiling corporate interests!!

Sincerely,
Carolyn Weinberger
2844 Garber Street
Berkeley CA 94705

C-62-1

The Proposed Action and alternatives do not specifically propose development of a resource. Therefore, the analysis relies on predictions of future development in the RFD scenario. Appropriate lease stipulations would be applied to protect resources, and site-specific analysis would be conducted prior to development and utilization.

C-62-2

The comment is noted.

C-62-3

This PEIS allocates areas as being available or closed to geothermal leasing. Stipulations have also been identified that would be applied to protect sensitive resources. Before issuing any leases, the BLM would conduct the necessary review to ensure that leasing would be compatible with the local land use plan and would comply with all applicable Federal, state, and local laws and regulations. As noted in Section 2.2.2, there are a variety of stipulations and BMPs that could be applied to protect sensitive issues and conditions.

geothermal_eis

From: Mary_Christensen@blm.gov [Mary_Christensen@blm.gov] **Sent:** Fri 9/19/2008 12:31 PM
To: geothermal_eis
Cc:
Subject: Mail forwarded from geothermal_eis@blm.gov
Attachments:

This message has been automatically forwarded from geothermal_eis@blm.gov.

"Diane Shockey" <shockeyd@comcast.net>
09/19/2008 01:29 PM

To <geothermal_EIS@BLM.gov>
cc
bcc
Subject Comments-Geothermal PEIS

I am a Medicine Lake homeowner in the Medicine Lake Highlands. I grew up in the area and spend as much time there as can be allowed during the summer.

I ask the BLM and the Forest Service to take no action on geothermal leasing decisions until individual Environmental Impact Statements are completed for each of the

public land areas that are under review.

The Medicine Lake Highlands and Mount Shasta should be completely excluded. I have seen the environmental damage the previous company, Calpines, has done to I-63-1

the areas surrounding Medicine Lake. It is shamefully clear that adequate assessments, planning, and oversite were NOT done by any of the government

agencies charged with the public trust.

I am skeptical that anything has changed and could well become worse unless appropriate impact studies are done before any leasing consideration begins.

Please consider my remarks and make a decision based on what is good for the public land involved.

From: Diane Shockey
517 Sandy Creek Road
Loganville, GA 30052

I-63-1

As described in Section 2.2.2 *Procedures Prior to Leasing*, prior to inclusion of a lease in a competitive bidding process, the BLM or FS would review the lease area for sensitive resources and would provide the necessary stipulations to protect these resources.

The authorized officer always retains the discretion to reject geothermal lease applications or lease parcels prior to issuance or sale, respectively.

It is also important to note that lands allocated as open to geothermal leasing are subject to existing laws, regulations, and formal orders, which could prohibit some lands from leasing.

ARIZONA DEPARTMENT OF WATER RESOURCES
3550 N Central Ave.
Phoenix, AZ 85012
602-771-8500 Ph.
602-771-8681 Fax

JANET NAPOLITANO
Governor

HERBERT R. GUENTHER
Director

September 15, 2008

Geothermal Programmatic EIS
c/o EMPSi
182 Howard Street, Suite 110
San Francisco, CA 94105

Re: "Draft Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States"

Dear Sir/Madam:

The Arizona Department of Water Resources (Department) has reviewed the "Draft Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States" dated May 2008 and we submit the following comments.

Under Arizona law:

> "The director [Department of Water Resources] has general control and supervision of surface water, its appropriation and distribution, and of groundwater to the extent provided by this title, except distribution of water reserved to special officers appointed by courts under existing judgments or decrees."
>
> Arizona Revised Statutes 45-103

The Department of Water Resources is thus the appropriate state authority for the Bureau of Land Management, Forest Service, other agencies and applicants to work with regarding water resources associated with geothermal energy development. In additional to roles associated with well permits and water rights identified on page A-8 of the draft PEIS, the Department is involved with administration of Active Management Areas and Safety of Dams rules at the state level. The State's Active Management Areas were established to provide long-term management and conservation of their limited groundwater supplies. In order to accomplish this the Active Management Area staffs administer state laws, explore ways of augmenting water supplies to meet future needs, and routinely work to develop public policy in order to promote efficient use and an equitable allocation of available water supplies. Maps and descriptions of Active Management Areas can be found at http://www.azwater.gov/dwr. A-64-1

Thank you for the opportunity to review this draft document. If you have any questions, please contact Mr. Bill Werner at 602-771-8412.

Sincerely,

Herbert R. Guenther

Herbert R. Guenther

A-64-1

Thank you for your comment. The BLM and FS recognize the Arizona Department of Water Resources as the state authority for applicants on water resources associated with geothermal development in Arizona.

PROGRAMMATIC EIS ON LEASING

I-65-1 •The PEIS violates the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA) by proposing a process to issue leases *granting exclusive rights to explore, produce and sell* geothermal energy *without requiring a site-specific analysis* of impacts on public lands *before the leases are granted.* There are *no provisions for denying a project* once geothermal leases are issued!

•The PEIS proposes to streamline the geothermal leasing process by *pre-approving areas* that would then require only minimal site-specific environmental review. The PEIS would make it possible to tier an abbreviated Environmental Assessment to the PEIS for subsequent *limited* site-specific analysis that purports to meet requirements under NEPA.

I-65-2 •The PEIS fails to disclose the *huge* problems encountered through a similar leasing process in areas such as the Medicine Lake Highlands, Newberry Crater, and Coso Hot Springs....

I-65-3 •The PEIS inadequately analyses 19 lease applications that have been pending prior to 2005.

•The PEIS must contain language that gives leasing agencies the right to *deny* a project based on site-specific conditions gathered through the NEPA and CEQA processes.

I-65-4 •The criteria for *closing lands to geothermal leasing* must be expanded to include *headwater sources*, sensitive Native American cultural areas, scenic lands used primarily for recreation, and lands containing fragile environmental resources and wildlife habitat....

I-65-5 •*Mount Shasta* and the *Medicine Lake Highlands* must be excluded from geothermal leasing!

More info on the PEIS

For more information on the PEIS, please see:www.blm.gov/wo/st/en/prog/energy/geothermal/geothermal_nationwide/Documents.html

Please submit a comment letter by September 19th

Please consider submitting a comment letter on the Draft PEIS by the September 19th deadline. Your letter could ask BLM and the Forest Service to withhold *all* geothermal leasing decisions until *individual* Environmental Impact Statements are completed for each of the specific areas that are contemplated for geothermal leasing *nominations* on 19 million acres of public lands, and to exclude Mount Shasta and the Medicine Lake Highlands from geothermal leasing, plus any of the points made in this article.

Comments can be sent via email to geothermal_EIS@BLM.gov; or faxed to 1.866.625.0707; or mailed to:

Geothermal Programmatic EIS,
c/o EMPSI
182 Howard Street, Suite 110
San Francisco, CA 94105.

I AM TOTALLY AGAINST this streamlining of REVIEW I've been to the MEDICINE LAKE HIGHLANDS AND THE 4-MILE HILL AREA AFTER IT WAS DEEMED NOT VIABLE FOR GEO THERMAL. CALPINE HAS TAKEN ADVANTAGE OF THE US GOVT AND USED FUNDS WASTEFULLY KNOWING FULL WELL THERE WAS'NT ENOUGH WATER TO MAKE IT WORK. THIS PROCESS WILL LEAD TO MORE LAW SUITS WHICH COULD BE PREVENTED. THE MONEY FOR GEO THERMAL SHOULD BE MORE THOUGHTFULLY USED IN AREAS THAT WILL SUPPORT THE DRILLING AND HAVE WHAT IS needed to MAKE IT WORK. THIS IS A BAD POLICY & DOES NOT PROTECT, the enviroment, the public, or GOVT FUNDS FROM BEING manipulATED BY greed, for a FEW. THIS IS JUST A WAY FOR A COMPANY to GET MONEY AND NOT BE HELD RESPONSIBLE. I HAVE SEEN IT IN ACTION FOR THE LAST 5 YEARS BY CALPINE, creating work for a few till the money runs-out. Why do you think theyre bankrupt so much of the time? I-65-6

530-677-7703

Peggy Kamer

I-65-1

Leasing geothermal resources vests with the lessee a non-exclusive right to future exploration and an exclusive right to produce and use the geothermal resources within the lease area subject to existing laws, regulations, formal orders, and the terms, conditions, and stipulations in or attached to the lease form or included as conditions of approval to permits. Permitting requires additional, site-specific NEPA analysis. Lease issuance alone does not authorize any ground-disturbing activities to explore for or develop geothermal resources without site-specific approval for the intended operation.

I-65-2

The purpose of the PEIS is to facilitate future geothermal leasing in an environmentally responsible manner. It is outside the scope of this PEIS to discuss the details of past leasing processes.

I-65-3

The comment is noted. The individual Forest Supervisors and BLM Field Office Managers will determine if the analysis contained in the PEIS is sufficient for their decision making.

I-65-4

This PEIS allocates areas as being available or closed to geothermal leasing. Stipulations have also been identified that would be applied to protect sensitive resources. Before issuing any leases, the BLM would conduct the necessary review to ensure that leasing would be compatible with the local land use plan and would comply with all applicable Federal, state, and local laws and regulations. As noted in Section 2.2.2, there are a variety of stipulations and BMPs that could be applied to protect sensitive issues and conditions.

I-65-5

As described in Section 2.2.2 *Procedures Prior to Leasing*, prior to inclusion of a lease in a competitive bidding process, including any leases in Mount Shasta or the Medicine Lake Highlands, the BLM or FS would review the lease area for sensitive resources and would provide the necessary stipulations to protect these resources. This review would include consultation with appropriate Native American Tribal Governments, as necessary.

I-65-6

The comment is noted.

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Comments can be sent via email to geothermal_EIS@BLM.gov; or faxed to 1.866.625.0707; or mailed to:

Geothermal Programmatic EIS,
c/o EMPSI
182 Howard Street, Suite 110
San Francisco, CA 94105.

9-16-08

I-66-6 I am against streamlining the process of geothermal leasing. Any of this planned for the Medicine Lake Area should not occur.

Patty Davidson
4245 Abraham Wy
Carmichael, CA 95608

I-66-1

Leasing geothermal resources vests with the lessee a non-exclusive right to future exploration and an exclusive right to produce and use the geothermal resources within the lease area subject to existing laws, regulations, formal orders, and the terms, conditions, and stipulations in or attached to the lease form or included as conditions of approval to permits. Permitting requires additional, site-specific NEPA analysis. Lease issuance alone does not authorize any ground-disturbing activities to explore for or develop geothermal resources without site-specific approval for the intended operation.

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Geothermal Programmatic EIS,
c/o EMPSI
182 Howard Street, Suite 110
San Francisco, CA 94105.

AFTER BEING AT MEDICINE LAKE FOR THE FIRST TIME AND SEEING WHAT CAL-PINE IS PROPOSING AND HAS ALREADY DONE, THE ONLY "GREEN" IN THIS IS THE FINANCIAL UPSIDE. I AM TOTALLY AGAINST THIS. I-67-6

MARK KESSELL
4245 ABRAHAM WY
CARMICHAEL, CA
916-944-0449

I-67-1

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As described in Section 2.2.2 *Procedures Prior to Leasing*, prior to inclusion of a lease in a competitive bidding process, including any leases in Mount Shasta or the Medicine Lake Highlands, the BLM or FS would review the lease area for sensitive resources and would provide the necessary stipulations to protect these resources. This review would include consultation with appropriate Native American Tribal Governments, as necessary.

I-67-6

The comment is noted.

September 12, 2008

Geothermal Programmatic EIS
c/o EMPS Inc.
182 Howard Street
Suite 110
San Francisco, CA 94105-1611

My name is Olivia ForrestDavis. I am a member of the Hewise Band of the Pit River Tribe. Our ancestral territory includes the North Warner Mountains area of northeastern California.

I am writing this letter in opposition to leasing of lands in the greater North Warner Mountains area for geothermal development. This area contains multiple, significant ceremonial sites for our people, and especially, my family. We continue to use this area for our spiritual needs. I-68-1

I oppose development on the pending lease application sites identified in Chapter 13 of the draft PEIS; especially CACA 043744 and CACA 043745. Although some scholars claim these sites are in historic Northern Paiute territory, this is also the ancestral land of our Band. In the old days, there were no definitive tribal boundaries and we shared resources and sacred sites. Our tribal territories overlapped. Therefore, these lease application sites for geothermal development are of great concern to me.

Any geothermal development would interfere with our present-day traditional ceremonial practices and alter the spiritual energy of the area at the application sites and surrounding mountains. I ask that no lease applications be approved here.

Sincerely,

Olivia M. Forrest Davis

Olivia M. ForrestDavis

cc: Michelle Berditschevsky, Coordinator, Pit River Tribe Environmental Dept.

I-68-1

As stated in PEIS Section 2.2.2 *Procedures Prior to Leasing*, the authorized officer for the BLM or FS will consult with Native American Tribal governments, Alaska Natives, and State Historic Preservation Officers. Through consultation, the agencies would identify tribal interests and traditional cultural resources or properties that may be affected by the federal leases and by potential geothermal energy development and the presence of archaeological sites and historic properties per Section 106 of the National Historic Preservation Act.

PROGRAMMATIC EIS ON LEASING

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•The criteria for *closing lands to geothermal leasing* must be expanded to include *headwater sources*, sensitive Native American cultural areas, scenic lands used primarily for recreation, and lands containing fragile environmental resources and wildlife habitat.... I-69-1

•*Mount Shasta* and the *Medicine Lake Highlands* must be excluded from geothermal leasing!

More info on the PEIS

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Please submit a comment letter by September 19th

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Comments can be sent via email to geothermal_EIS@BLM.gov; or faxed to 1.866.625.0707; or mailed to:

Geothermal Programmatic EIS,
c/o EMPSI
182 Howard Street, Suite 110
San Francisco, CA 94105.

*FAX ATTACHED

Sept. 18, 2008
Carmichael, CA 95608

To the attention of the B.L.M. + Forest Service,

As an annual visitor to the Medicine Lake Recreation Area in Northern California, Siskiyou County, I am very concerned over the proposed opening of that area to geothermal development. My family and I have observed over a number of years the attempt by several energy companies to develop thermal wells on lands close in to Medicine Lake. These have not been successful because water is not readily available in sufficient quantities to provide the necessary steam unless drawing from Medicine Lake which needs to be allowed. This is not a large lake and fed by springs and snow water. It is totally inappropriate. There have been a razing of trees for such use. There have been well + drill sites built and left unused, some poorly protected from ponds of contaminated water, these wells have not been profitable. The public and wildlife. I-69-2

I would like to see you withdraw all geothermal leasing decisions until individual Environmental Impact Statements are completed for each of the specific areas contemplated for geo developments on 19 million acres of public lands. And in particular to exclude Mt. Shasta and Medicine Lake Highlands from geothermal leasing. This is Native American cultural area, scenic land and primarily suited to recreation + wildlife habitat.

Sincerely,

Vera J. Karnes
3941 La Honda Way
Carmichael CA
95608

916 944-1912

I-69-1

This PEIS allocates areas as being available or closed to geothermal leasing. Stipulations have also been identified that would be applied to protect sensitive resources. Before issuing any leases, the BLM would conduct the necessary review to ensure that leasing would be compatible with the local land use plan and would comply with all applicable Federal, state, and local laws and regulations. As noted in Section 2.2.2, there are a variety of stipulations and BMPs that could be applied to protect sensitive issues and conditions.

I-69-2

Additional handwritten comments are not legible.

Medicine Lake Citizens for Quality Environment, Inc.
PO Box 34
Mt. Shasta, CA. 96067
530-926-5514, phone
530-926-1598, fax

September 17, 2008

Geothermal Programmatic EIS
C/o EMPSI
182 Howard Street, Suite 110
San Francisco, CA. 94105

Re: Programmatic Environmental Impact Statement (PEIS)

The PEIS violates the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA) by proposing a process to issue leases granting exclusive rights to explore, produce and sell geothermal energy without requiring a site-specific analysis of impacts on public lands before the leases are granted. There are no provisions for denying a project once geothermal leases are issued. The PEIS must contain language that gives leasing agencies the right to deny a project based on site-specific conditions gathered through the NEPA and CEQA process. O-70-1

The issuance and renewal of geothermal leases at Medicine Lake has involved over ten years of numerous hearings, public comments, legal appeals, and lawsuits, yet the federal agencies are again considering the same faulty process in the PEIS. O-70-2

The criteria for closing lands to geothermal leasing must be expanded to include headwater sources, sensitive Native American cultural areas, scenic lands used primarily for recreation, and lands containing fragile environmental resources and wildlife habitat. Medicine Lake Highlands and Mount Shasta must be excluded from geothermal leasing.

A board member for the Medicine Lake Citizens for Quality Environment attended the public hearing in Sacramento, and was told that cultural areas and recreational areas would be given serious consideration for closing lands for geothermal leasing. This should be considered on the top of the list in the PEIS. This should be considered top priority for the damage that will be done to the Native American cultural area and the recreation area. The damage would be irreversible. O-70-3

Geothermal development industrializes an area and has adverse impacts on air, water, wildlife habitat recreational areas and Native American cultural values.

Thank you for considering my comment.

Jim Shott

Jim Shott
Medicine Lake Citizens for Quality Environment
605 Glen Mar Drive
Mt. Shasta, CA. 96067

O-70-1

Leasing geothermal resources vests with the lessee a non-exclusive right to future exploration and an exclusive right to produce and use the geothermal resources within the lease area subject to existing laws, regulations, formal orders, and the terms, conditions, and stipulations in or attached to the lease form or included as conditions of approval to permits. Permitting requires additional, site-specific NEPA analysis. Lease issuance alone does not authorize any ground-disturbing activities to explore for or develop geothermal resources without site-specific approval for the intended operation.

O-70-2

As described in Section 2.2.2 *Procedures Prior to Leasing*, prior to inclusion of a lease in a competitive bidding process, the BLM or FS would review the lease area for sensitive resources and would provide the necessary stipulations to protect these resources. This review would include consultation with appropriate Native American Tribal Governments, as necessary.

O-70-3

Before issuing any leases, the BLM would conduct the necessary review to ensure that leasing would be compatible with the local land use plan and would comply with all applicable Federal, state, and local laws and regulations. As noted in Section 2.2.2, there are a variety of stipulations and BMPs that could be applied to protect sensitive issues and conditions.

MR. JACK PETERSON
BLM IDAHO STATE OFFICE
1387 S. VINDELL WAY
BOISE IDAHO 83906

RECEIVED
BLM ISO MR
SEP 19 2008
9:00 A.M.

SEPTEMBER 18 2008

VIEWPOINTS AGAINST GEOTHERMAL AT THE MEDICINE LAKE HIGHLANDS

HOW CAN THE U.S. FEDERAL GOVERNMENT ALLOW THIS??

I-71-1 Geo thermal development will threaten not only a beautiful pristine area, but possibly ruin our aquaducts and cultural areas sacred to different tribes in the area. Medicine Mountain is still used for COMING OF AGE rituals by young men.

HOW CAND THE U.S. FEDERAL GOVERNMENT ALLOW THIS ??

I-71-2 The PEIS fails to disclose huge problems encountered in similar leasing process in areas such as the MEDICINE LAKE HIGHLANDS NEWBERRY CRATER AND COSO HOT SPRINGS.

I-71-3 The PEIS inadequately analyses 19 lease applications that have been pending prior to 2005.

THE CRITERIA FOR CLOSING LANDS TO GEOTHERMAL LEASING AGENCIES THE RIGHT TO DENY A PROJECT BASED ON SITE SPECIFIC CONDITIONS GATHERED THROUGH THE NEPA AND CEQA PROCESSES.

I-71-4 THE CRITERIA FOR CLOSING LANDS TO GEOTHERMAL LEASING MUST BE EXPANDED TO INCLUDE HEADWATER SOURCES , sensitive native american CULTURAL AREAS, SCENIC LANDS USED PRIMARILY FOR RECREATION, AND LANDS CONTAINING FRAGILE ENVIRONMENTAL RESOURCES AND WILDLIFE HABITAT,

MOUNT SHASTA AND THE MEDICINE LAKE HIGHLANDS MUST BE EXCLUDED FROM GEOTHERMAL LEASING.

PLEASE BLM AND U. S. FOREST SERVICE

I-71-5 PLEASE WITHHOLD ALL GEOTHERMAL LEASING DECISIONS UNTIL INDIVDUAL ENVIORNMEMTAL IMPACT STATEMENTS ARE COMPLETED FOR EACH OF THE SPECIFIC AREAS THAT ARE CONTEMPLARED FOR GEOTHERMAL LEASING NOMINATIONS ON 19 MILLION ACRES OF PUBLIC LAND AND TO EXCLUDE MOUNT SHASTA AND MEDICINE LAKE HIGHLANDS FROM GEOTHERMAL LEASING.

WHAT US CITIZEN WANTS INDUSTRY CITIES IN THE MIDST OF OUR PARKLANDS ??

SINCERELY,

Trudy C. Eastman

TRUDY C. EASTMAN CONCERNED CITIZEN
PO 577
TULELAKE, CALIFORNIA 96134

I-71-1

As described in Section 2.2.2 *Procedures Prior to Leasing*, prior to inclusion of a lease in a competitive bidding process, the BLM or FS would review the lease area for sensitive resources and provide the necessary stipulations to protect these resources. This review would include consultation with appropriate Native American Tribal Governments, as necessary.

I-71-2

The purpose of the PEIS is to facilitate future geothermal leasing in an environmentally responsible manner.

It is outside the scope of this PEIS to discuss the details of past leasing processes.

I-71-3

The comment is noted. The individual Forest Supervisors and BLM Field Office Managers will determine if the analysis contained in the PEIS is sufficient for their decision making.

I-71-4

This PEIS allocates areas as being available or closed to geothermal leasing. Stipulations have also been identified that would be applied to protect sensitive resources. Before issuing any leases, the BLM would conduct the necessary review to ensure that leasing would be compatible with the local land use plan and would comply with all applicable Federal, state, and local laws and regulations. As noted in Section 2.2.2, there are a variety of stipulations and BMPs that could be applied to protect sensitive issues and conditions.

I-71-5

As described in Section 2.2.2 *Procedures Prior to Leasing*, prior to inclusion of a lease in a competitive bidding process, the BLM or FS would review the lease area for sensitive resources and would provide the necessary stipulations to protect these resources.

The authorized officer always retains the discretion to reject geothermal lease applications or lease parcels prior to issuance or sale, respectively.

It is also important to note that lands allocated as open are subject to existing laws, regulations, and formal orders, which could prohibit some lands from leasing.

5318 Chief Brown Lane
Darrington, Washington 98241-9420
Health & Social Services
(360) 436-1400
Fax (360) 436-0242

September 18, 2008

Jack G. Peterson
U.S. Bureau of Land Management

Electronic Correspondence

Reference: Draft Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States

Dear Mr. Peterson:

The Sauk-Suiattle Indian Tribe is a federally recognized Indian Tribe and a signatory to the Treaty of Point Elliot of 1855. This letter serves as the Sauk-Suiattle Tribe's comments on the Programmatic Environmental Impact Statement (PEIS) and the four pending lease applications in the Mount Baker-Snoqualmie National Forest.

<u>Draft Programmatic EIS</u>

The Bureau of Land Management (BLM) proposes to programmatically open federal lands in 12 western states to geothermal leasing. The geographic scale of this proposed action and the varied A-72-1 environmental conditions are too great to deal with programmatically. The appropriate decision level for evaluating geothermal development as an appropriate land use activity is the BLM District Office and National Forest Service (NFS) Forest Office. At the BLM District or NFS Forest level appropriate detail of analysis and local environmental knowledge can best determine if geothermal development is appropriate on the district or forest. The environmental analysis in the PEIS is too broad to support the proposed action to open 192 million acres of federal land to geothermal leasing. The Sauk-Suiattle Tribe supports the No Action Alternative which leaves the decision to amend land use plans to include geothermal leasing at a local level.

<u>Pending Lease Applications in the Mount Baker-Snoqualmie National Forest</u>

All four lease areas lie within the core area of the Nooksack Elk Herd. The Nooksack Elk Herd A-72-2 population has been depressed for a number of years with a low population estimate of 300 in

2001. Despite intensive efforts by the Tribes and the Washington Department of Fish and Wildlife (WDFW) the current population estimate of 700 elk remains approximately 40 percent below the WDFW and Tribal population goal. Geothermal development in the core area of the Nooksack Herd may retard the recovery the Tribes are working so hard to achieve. Elk are sensitive to disruption by human activity including noise levels that would be associated with geothermal production. Geothermal development may disrupt migratory pathways and may drive the Nooksack herd off a portion of its range. There is not sufficient analysis in the Analysis of Pending Lease Applications of the effect of geothermal development on the Nooksack Elk Herd to justify granting leases.

In addition, there are several important salmon bearing tributaries to Baker Lake in the proposed lease areas. Survival of salmon may be reduced by runoff of geothermal fluids or industrial pollutants. Geothermal development in the Baker River Basin may reduce the Tribe's ability to harvest salmon.

Geothermal development in the Baker River basin may adversely impact fish and wildlife resource that are essential to the Sauk-Suiattle Tribe's way of life. There is not sufficient detail in the environmental analysis to evaluate the potential of that impact. This level of analysis does not meet BLM's or NFS's trust responsibility to the Sauk-Suiattle Tribe for the protection of tribal resources.

If the BLM and NFS intend to issue any of the four leases in the Baker River Basin the Sauk-Suiattle Tribe requests direct government to government consultation before the final decision is made.

The Sauk-Suiattle Indian Tribe appreciates the opportunity to comment on the Geothermal PEIS and proposed leases on the Mount Baker-Snoqualmie National Forest. If you have any questions about our comments or would like to set up a government to government consultation please contact Stan Walsh of the Skagit River System Cooperative at (360) 466-1512 or email swalsh@skagitcoop.org.

Sincerely,

for
Cynthia Harris, Chairperson
Sauk-Suiattle Indian Tribe

cc Rob Iwamoto, Mount Baker-Snoqualmie Forest Supervisor
Jon Vanderheyden, Mount Baker District Ranger
Tracy Parker, U.S. Forest Service National Energy Mineral Program Director
Stan Walsh, SRSC
Richard Wolten, Sauk-Suiattle NR Director

Regina Hovet, Sauk-Suiattle Office of Legal Counsel
Brian Cladoosby, Swinomish Indian Tribal Community
Scott Schuyler, Upper Skagit Indian Tribe
File

A-72-1

The Tribe's support for the No Action alternative is noted.

A-72-2

Consultation will occur prior to site-specific development and utilization of the geothermal resource.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Washington, D.C. 20240

SEP 2 6 2008

In Reply Refer To:
FWS/DHRC/BCPA/DCN-037587

Memorandum

To: Director, Bureau of Land Management

From: Deputy Director Kenneth Stansell

Subject: Comments on the Bureau of Land Management's (BLM) Draft Programmatic Environmental Impact Statement for Leasing of Geothermal Resources in 11 Western States and Alaska (EC08/0005)

The U.S. Fish and Wildlife Service (Service) has reviewed the Bureau of Land Management (BLM) and Forest Service (FS) Draft Programmatic Environmental Impact Statement (PEIS), and has prepared the enclosed detailed comments pursuant to the: (1) Fish and Wildlife Coordination Act; (2) Endangered Species Act; (3) Migratory Bird Treaty Act; (4) the Clean Water Act; (5) National Wildlife Refuge System Administration Act of 1966; (6) Energy Policy Act of 2005 (EPAct), and other applicable Executive Orders, regulations and policies.

We acknowledge the need for the development of renewable energy and we commend BLM for its comprehensive approach in the Draft PEIS. We have provided General Comments in Attachment 1 and Specific Technical Comments in Attachment 2 to assist BLM in preparation of the Final PEIS. Attachment 3 is an existing species conservation agreement with the Utah BLM office for oil and gas lease sales. Our comments focus on the need to consider habitat, prioritize development in areas with existing infrastructure, consider all effects of development including groundwater, and to work cooperatively with the Service as specific development proposals are considered

We appreciate the opportunity to provide comments and recognize BLM for their efforts to coordinate with the Service. We look forward to continuing to work together with the BLM, FS and other agencies and stakeholders through this process. Please contact Mr. Gary Frazer, Assistant Director - Fisheries and Habitat Conservation, at (202) 208-6394 or Nancy Lee, Chief, Branch of Conservation Planning Assistance, at (703) 358-2440 if you have any questions.

Attachments

cc: 3245/AFHC 840/DFHC 840/DHRC/BCPA 840/DHRC/BCPA Staff
FWS/DHRC-BCPA/SStavrakas:lem:9-16-08/703-358-2161/S/DHRC/DTS ‘08/037587

Attachment 1

Fish and Wildlife Service (Service) General Comments on the Bureau of Land Management's (BLM) Draft Programmatic Environmental Impact Statement for Leasing of Geothermal Resources in 11 Western States and Alaska (EC08/0005)

GENERAL COMMENTS

1. Consideration for Siting of Geothermal Projects

Large-scale, disjunct geothermal energy projects may compromise recovery of listed species and otherwise negatively impact numerous additional species, through habitat loss, population and habitat fragmentation, changes in water flow (both surface and groundwater), introduction of pollutants and non-native species, mortality by vehicle encounters, and alterations to natural predator-prey dynamics. Alterations to conservation areas, defined as lands targeted for species conservation such as Desert Wildlife Management Areas, Wildlife Management Areas, Areas of Critical Environmental Concern, and designated critical habitat may be affected by geothermal development. These land designations were assigned because these areas are considered environmentally sensitive and play an important role in the recovery and conservation of listed and sensitive species. The Service recommends that these areas be removed from consideration for geothermal development and minimization of edge-effects to these areas. A-73-1

In addition to avoiding ecologically-sensitive lands, the Service recommends that the Draft PEIS prioritize geothermal development and first focus on lands already disturbed. Such sites are often close to existing infrastructure which would decrease potential habitat disturbance from new roads and transmission lines.

2. Invasive Species

As with all projects that require surface disturbance, there is a high potential for introduction and spread of non-native, invasive weeds. The spread of invasive species is known to alter fire ecology and increased frequency of wildfire. The Service recommends incorporating all possible measures to prevent the introduction or further proliferation of invasive species including standard stipulations specific to mitigation, revegetation, and restoration efforts for impacts to wildlife and plant habitats. Additionally, the Service recommends that BLM and FS require monitoring and performance standards to address invasives as an element of the leasing program. Finally, we recommend avoiding development in contiguous blocks of healthy sagebrush. A-73-2

3. Cumulative Impacts

"Cumulative impact" is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person A-73-3 undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Because of the number of applications already received and an unknown number expected to be submitted, the cumulative impacts of renewable energy projects, including solar, wind, and geothermal energy on listed, sensitive, and other wildlife and plant species are likely to be substantial. In particular, there is potential wide-spread loss, degradation, or fragmentation of habitats due to direct, indirect, or cumulative effects of numerous large-scale renewable energy projects on public lands. As a result recovery of threatened and endangered species may be impeded and there may be an increased risk of extirpation or extinction. In addition, other species may be affected to the point where listing may be warranted. Although the Service is supportive and recognizes the need for development of renewable energy, we are concerned that the magnitude and severity of impacts from the many large-scale projects on Federal lands may have significant and unintended adverse consequences on our trust resources.

The Service recommends addressing affects of geothermal energy development, taking into consideration other renewable development within each State, on the landscape. Factors to consider in these analyses include:

1) Total acres affected by all proposed development and acreage of Service trust resources affected, e.g. acres of refuges, hatcheries, critical habitat, etc.;

2) The geographic scope of the proposed action, in relationship to affected trust resources and their supporting habitat, in terms of habitat loss and degradation, population decline, water quality and quantity, and related impacts;

3) The relevant timeframe in which the potential impacts will likely occur, e.g. over the next 50 years; and

4) The collective impact of the proposed action on trust resources, when considered together with the existing policies or proposals of other jurisdictions, e.g. federal, state, regional, local, tribal.

4. National Wildlife Refuges

Based on the National Wildlife Refuge System Administration Act (NWRSAA) of 1966 (16 USC 668 [dd]), National Wildlife Refuges should be excluded from the planning area. Any enterprise conducted on a refuge has to meet the compatibility standard. The Service believes geothermal energy facility would not meet the compatibility standard. A-73-4

The Service recommends adding lands managed by the National Wildlife Refuge System to the list of areas excluded from the planning area based primarily on the National Wildlife Refuge System Administration Act (NWRSAA) of 1966 (16 USC 668 [dd]) and other existing laws.

Attachment 2

Fish and Wildlife Service (Service) Specific Technical Comments on the Bureau of Land Management's (BLM) Draft Programmatic Environmental Impact Statement for Leasing of Geothermal Resources in 11 Western States and Alaska (Draft PEIS) (EC08/0005)

SPECIFIC TECHNICAL COMMENTS

VOLUME I

Chapter 1

- *On page 1-33, section 1.13.10.*

The first full paragraph states that the "Migratory Bird Conservation Act makes it unlawful…." The Migratory Bird Conservation Act allows for the "acquisition, including the location, examination, and survey, of suitable areas of land, water, or land and water, for use as migratory bird reservations…." A-73-5

The Service recommends amending the above passage to reference the Migratory Bird Treaty Act, as amended (MBTA), which was implemented for the protection of migratory birds. We also recommend including Executive Order 13186 in your discussion of the MBTA in section 1.13.10. The MBTA makes it unlawful to pursue, hunt, kill, capture, possess, buy, sell, purchase, or barter any migratory bird, including the feathers or other parts, nests, eggs, or migratory bird products. Executive Order 13186, signed January 10, 2001, sets forth the responsibilities of Federal agencies to further implement the provisions of the MBTA by integrating bird conservation principles and practices into agency activities by ensuring that Federal actions evaluate the effects of actions and agency plans on migratory birds.

Chapter 2

- *Page 2-7, proposed areas closed for geothermal leasing: Sensitive Habitats for Federally Listed Species and Sensitive Wildlife.*

Based on staff-level coordination between the Service and the BLM, we developed a Priority Special Management Areas map for the California Desert Conservation Area (CDCA) and presented it to BLM representatives at a meeting on June 27, 2008. The map largely depicted lands with various levels of planned conservation per BLM's bioregional management plans [Northern and Eastern Mojave Plan, Northern and Eastern Colorado Plan, Western and Eastern Colorado Plan, etc.] and serves as the basis for recommending areas that are environmentally sensitive and not suitable for extensive, surface disturbing uses. The Service recommends the following special management areas within the CDCA be considered not suitable for development: A-73-6

- Designated critical habitat for federally listed species,
- Desert Wildlife Management Areas,
- Wildlife Habitat Management Areas,
- Core habitat and linkages for desert tortoise (*Gopherus agassizii*) and desert bighorn sheep (*Ovis canadensis*),
- Sand dunes and playa habitats,
- Flat-tailed horned lizard (*Phrynosoma mcallii*) management areas, and
- Other special management areas identified in the CDCA Plan.

▪ *Page 2-7, proposed areas closed for geothermal leasing: Sensitive Habitats for Federally Listed Species and Sensitive Wildlife.*

We are currently evaluating the status of the greater sage-grouse (*Centrocercus urophasianus*) and pygmy rabbit (*Brachylagus idahoensis*) under the Endangered Species Act of 1973, as amended (ESA) through our 12-month status review process. Both species are widely distributed throughout the western United States, occurring on much of the BLM and FS managed lands under evaluation for this Draft PEIS. Although the specific elements of their respective habitats vary, sage-steppe ecosystems are a primary habiatat component for both species and would likely be similarly impacted from geothermal energy development. Sage-grouse are sensitive to a variety of disturbances above and beyond the physical footprint of site development including noise, habitat fragmentation, and presence of tall structures such as transmission lines. The Service recommends conducting a thorough analysis and comparison of siting locations to determine how they may affect seasonal habitats and movement patterns of the greater sage-grouse, similar to the approach currently recommended by the Service for the siting of wind turbines. Additionally, we recommend curtailing development in these areas. A-73-7

▪ *Page 2-7, proposed areas closed for geothermal leasing: Riparian Areas and Wetlands.*

Streams, seeps, springs, and isolated wetlands are important aquatic features in the arid west that provide habitat for many species of macroinvertebrates, amphibians, reptiles, fish, birds, mammals, and plants. Many of the Service trust resource species occur within these habitats, and may be highly localized. Upland buffers around these aquatic habitats provide a zone of protection from areas of development. Upland buffers also provide corridors for wildlife movement, nesting habitat, and upland foraging habitat in conjunction with water quality protection. The Service recommends avoiding impacts to these areas, and considering both aquatic habitats and the adjacent upland buffers in project-specific design. Because of their importance and relative scarcity in the arid southwest, impacts to aquatic and riparian resources should be avoided and unavoidable impacts should be mitigated. A-73-8

- *Page 2-7, proposed areas closed for geothermal leasing: Additional Areas of Avoidance.*

The Amargosa toad (*Bufo nelsoni*), a toad species endemic to the Oasis Valley in Nevada and protected under Nevada State law, may be impacted by geothermal development. A conservation agreement was completed in 2000, which identifies specific conservation measures that are expected to reduce or eliminate threats to the species, enhance habitat, and maintain a properly functioning ecosystem for the species of Oasis Valley. This species is mostly at risk from depletion of the Amargosa River and groundwater resources within the hydrologic basin. Geothermal development has the potential to reduce groundwater resources, and affect the quantity and quality of habitat for the toad in the Oasis Valley. The Service is currently reviewing the Amargosa toad status. A-73-9

Development in Independence Valley and Clover Valley in Elko County may affect the presence of small endemic populations of fish associated with local systems. The two species of speckled dace associated with these areas are listed under the ESA but do not currently have designated critical habitat.

Geothermal development has the potential to directly and indirectly impact the Amargosa toad and small endemic fish populations and their habitats. In addition, groundwater withdrawal that may be required to run the geothermal facilities may affect these habitats. We recommend that Oasis, Independence, and Clover Valleys be excluded from geothermal leasing by BLM and FS and added to the list of areas closed to geothermal lease.

- *Table 2-1 on page 2-9.* The City of Vernal is shown as occurring in Wyoming. The City of Vernal is located in Utah. Please update the table. A-73-10

<u>Chapter 3</u>

- *Page 3-11 land management plans.*

The Draft PEIS has identified Critical Biological Zones as part of FS Land Management Plans in the Angeles, Cleveland, Los Padres, and San Bernardino national forests. According to the Land Management Plans, “Activities and modification to existing infrastructure are allowed if they are beneficial or neutral to the species for which the zone was primarily designated” (USFS 2005[1], Part 2, page 9). Critical Biological Zones are zoned as not being suitable for numerous activities including activities related to renewable energy resources (USFS 2005, Part 2, page 6). The Service recommends designated critical habitat be considered as a Critical Biological Zone and be excluded on these national forests from geothermal leasing. A-73-11

[1] USFS (U. S. Forest Service). 2005. Land management plan, Angeles National Forest, Cleveland National Forest, Los Padres National Forest, San Bernardino National Forest.

- *Pages 3-136 – 3-140, Migratory Birds.*

To complete BLM and FS migratory bird analysis, the Service recommends including the following measures:

  - Land clearing, or other surface disturbance associated with proposed projects, should be conducted outside the avian breeding season to avoid potential destruction of bird nests or young, or birds that breed in the area. If this is not feasible, a qualified biologist may survey the area prior to land clearing. If nests are located, or if other evidence of nesting (*i.e.*, mated pairs, territorial defense, carrying nesting material, transporting food) is observed, a protective buffer (the size depending on the habitat requirements of the species) should be delineated and the entire area avoided to prevent destruction or disturbance to nests until they are no longer active.

  - Incorporate the Guidelines into the Draft PEIS as voluntary guidelines for construction and operation of proposed transmission lines. These guidelines may help prevent avian electrocution from use of transmission lines that may be associated with the geothermal energy development. The APP Guidelines can be found at www.aplic.org. A-73-12

  - Avoid occupied nests for the western burrowing owl (*Athene cunicularia hypugea*). The western burrowing owl is a BLM sensitive species and identified by the Service as a bird of conservation concern. The reduction of habitat in southern Nevada is a major threat to this species. If avoidance is not possible, please incorporate our recommendations in the Service pamphlet, "Protecting Burrowing Owls at Construction Sites in Nevada's Mojave Desert Region" (Attachment 1), into the Best Management Practices for geothermal energy development projects.

  - Refer to our raptor guidance for proposed facilities or structures during construction to prevent bird injury and/or entrapment in the Mojave Desert.

<u>Chapter 4</u>

- *Page 4-93 habitat fragmentation.*

This section states that best management practices will effectively minimize impacts. The Draft PEIS does not describe impacts to wildlife. Although best management practices will help to minimize the impacts to migratory birds and other wildlife, the Service recommends the Draft PEIS disclose and discuss the suite of impacts that would result from geothermal energy development including habitat fragmentation, habitat loss, and increased predation. A-73-13

- *Page 4-95, Section 4.11.2 potential effects of geothermal leasing on threatened and endangered species.*

The Service recommends amending the criteria used in the evaluation of threatened and endangered species as follows: A-73-14

  - The first bullet should reflect that an adverse affect to a listed species <u>would</u> occur if the action resulted in impacts that violated the ESA, Bald and Golden Eagle Protection Act (BGEPA), MBTA; and
  - The second bullet should reflect that <u>any</u> impact to an individual of a federally listed species is an adverse impact.

<u>Chapter 6</u>

- *Page 6-4, Endangered Species Act Consultation.*

Section 7 of ESA consultation process and procedures are not clearly depicted in this section. The Service recommends BLM and FS clarify how they will comply with Section 7 consultation. Additionally, please identify at what level consultation will be initiated. A-73-15

- *Page 6-4, Endangered Species Act Consultation – Listed and Sensitive Species and Surface and Groundwater Withdrawal.*

Proposed geothermal energy projects may affect listed and sensitive species dependent on regional groundwater flow systems. Desert fish species may be impacted by small changes in groundwater levels, water quality, or flow patterns, as many inhabit spring systems that are recharged by one of these systems. Potential long-term hydrological effects and impacts to federally listed and sensitive species as they relate to geothermal energy projects should be carefully considered. Water may be needed in significant amounts for power generation, depending on the technology used for the proposed geothermal energy projects. Reductions in groundwater flows and the ability to recharge associated aquifers can result in surface hydrological changes on hundreds of thousands of acres. A-73-16

The Service recommends including in the NEPA review, as well as in the BLM and FS lease permits, quantification and analyses of expected surface and groundwater requirements to construct, operate, and maintain geothermal facilities and assessment of potential impacts to the aquatic resources, associated terrestrial resources, and wildlife species and plants. The evaluation should also include both the use of groundwater by individual projects and the impacts to desert washes that feed dry lakes and aid the recharge of groundwater. The Service is available to work with BLM and/or FS to best determine the scope and scale of this analysis.

Additionally, the Service recommends the Draft PEIS include the best management measures or some other identification of measures that will be taken during project planning, construction, and operation to avoid, minimize, and mitigate impacts to listed and sensitive species that are dependent on surface and groundwater resources. The Service also recommends the BLM and FS include in their policy a requirement that project proponents must use technology that utilizes the least amount of water for power generation.

- *Page 6-4, Endangered Species Act Consultation – Habitat Loss, Degradation, and Fragmentation.*

Significant portions of land that will be considered for geothermal energy development in the Draft PEIS contain priority ecological areas (e.g. existing conservation lands, including Federal Wilderness Areas, Aquatic Preserves, National Estuarine Research Reserves, Wild & Scenic Rivers, roadless areas of native habitat or Category 1 lands) and migration linkages between these areas. Habitat loss and fragmentation on such a large scale would affect the structure and function of the landscape for wildlife. Activities adjacent to lands allocated for conservation (National Landscape Conservation System lands, Areas of Critical Environmental Concern (ACEC), Wildlife Habitat Management Areas, Desert Wildlife Management Areas, National Wildlife Refuge System lands, National Park Service lands, designated critical habitats, etc.) can affect animal and plant populations and the effectiveness of conservation and recovery actions occurring within these management area boundaries. The Service believes that lands already designated for conservation should be the baseline for focus of recovery efforts. A-73-17

The Service recommends BLM and FS use the information in State Wildlife Plans, species recovery plans, designated critical habitat, Audubon important bird areas, and other sensitive habitats (as mentioned above), to conduct a thorough analysis of habitat loss and fragmentation on a landscape level. This information should be used to make informed decisions regarding lands, as available, for geothermal energy development.

VOLUME II – Case Specific

<u>Chapter 10</u>

- *Proposed Action to Issue Leases in Nye County, Nevada (NVN 074289) and Modoc County, California (CACA 042989, CACA 043744, CACA 043745)*

The Service responded to a Species List request initiated by Environmental Management Associates on behalf of Lake City Geothermal, LLC on December 10, 2004. Although the details of the proposed action are slightly different, it appears the original Species List request corresponds to the pending lease applications described in the Draft PEIS occurring in Modoc County, California. Contained within our response was a list of species that may occur within the proposed project area and be affected by the proposed project. This list included the Modoc sucker (*Castostomus microps*), Carson wandering skipper (*Pseudocopaeodes eunus obscurus*), bald eagle (*Haliaeetus leucocephalus*), Warner sucker (*Catostomus warnerensis*), slender orcutt grass (*Orcuttia tenuis*), and Western yellow-billed cuckoo (*Coccyzus americanus*). Since this time, the bald eagle has A-73-18 been removed from the list of threatened and endangered species maintained by the Fish and Wildlife Service. However, the species is still protected by the BGEPA and as such deserves continued consideration.

The proposed action in Nye County, Nevada may occur in greater sage-grouse and pygmy rabbit habitat. Additionally, there is an endemic fish species (Big Smoky Valley tui chub (*Gila bicolor spp.*)) that occurs in the area. The Service recommends coordinating with the local U.S. Fish and Wildlife Service Office for project specific details.

Appendix A – State of States and State of Tribal Lands

- Please describe the current status of the Blundell geothermal plant. According to the first full paragraph on page A-38, the Blundell geothermal plant was expected to expand operations with additional binary units due to go online in November 2007. A-73-19

- Figure A-40 is not legible. The Service recommends improving the quality of this figure. A-73-20

Appendix C – Preliminary List of Areas of ACEC Status

- Appendix C lists areas with ACEC status throughout the project area, with the exception of ACECs occurring in the State of Utah. The Service recommends amending this list to include ACECs in Utah. The following web-site provides a list of current ACECs designated in Utah: http://www.blm.gov/ut/st/en/prog/blm_special_areas/acecs/utah_acecs.html. A-73-21

Appendix D – Best Management Practices (BMP)

- The Service recommends that a separate section for threatened and endangered species be included in Appendix D. A-73-22

- Appendix D has the following BMPs repeated throughout all phases of geothermal exploration, development and restoration "Drip pans should be used under fuel pumps and valve mechanisms…." The Service recommends any containers used to collect liquids be enclosed to prevent access to contaminants by wildlife and migratory birds. A-73-23

- Another BMP repeated is "Employees, contractors, and site visitors should be instructed to avoid harassment and disturbance of wildlife, especially during reproductive (e.g., courtship and nesting) seasons. In addition, pets should be controlled to avoid harassment and disturbance of wildlife." In occupied habitat of certain federally listed species (i.e. desert tortoise), the Service recommends that pets not be allowed. In addition, we recommend no disturbance on or around wildlife during reproductive seasons. The Service recommends working with the local field office for appropriate time restrictions during nesting and breeding seasons for specific species. A-73-24

- Two measures repeated throughout are, "The BLM, FS, and operators should contact appropriate agencies early in the planning process to identify potentially sensitive ecological resources that may be present in the area of proposed geothermal development" and "The operators should conduct surveys for federal- and state protected species and other species of concern within the project area." We recommend including BMPs that will commit to the identification of appropriate conservation measures based on survey results and consultation with the Service. A-73-25

- The Service's Utah Field Office has worked with the Utah BLM to determine conservation measures for oil and gas development that provide protection to listed species. These conservation measures are provided in an attachment to these comments. Because the Draft PEIS describes the impacts of geothermal resource development as comparable to those of oil and gas resource development, the Service recommends that the conservation measures jointly prepared for oil and gas development also be incorporated into the Geothermal Energy Draft PEIS. A-73-26

- Some of the BMPs under phase 4, reclamation and abandonment, for vegetation and fish and wildlife do not appear to apply to this phase of geothermal resource development. For instance, some of the measures discuss development of new access roads. The Service recommends removing measures that do not actually apply to this phase of geothermal resource development and including BMPs for monitoring to ensure that desired conditions are met after final reclamation and abandonment of sites. A-73-27

Appendix H – Federally Listed Species

- Appendix H contains all federally listed species. Not all of the species listed would actually be impacted by geothermal resource development projects. Additionally, some noted species and critical habitat areas are not accurately noted. The Service recommends the following amendments to the species list:

  - Maguire daisy occurs from the San Rafael Swell in Emery County, Utah, south into Wayne and Garfield Counties, Utah, through the Waterpocket Fold in Capitol Reef National Park. The range of the species does not occur within the planning area of your Draft PEIS (figure 2-1, page 2-2). A-73-28

  - The Eskimo curlew does not occur in Utah; please see the species information at http://ecos.fws.gov/speciesProfile/SpeciesReport.do?spcode=B01A.

  - The grizzly bear has been extirpated from Utah; please see the species information at http://ecos.fws.gov/speciesProfile/SpeciesReport.do?spcode=A001.

  - The Mesa Verde cactus does not occur in Utah; please see the species information at http://ecos.fws.gov/speciesProfile/SpeciesReport.do?spcode=Q21J.

- Shrubby reed-mustard, *Schoenocrambe suffrutescens*, is listed as occurring in "Y", it should be "UT".

- Munz's onion (*Allium munzii*), Bear Valley sandwort (*Arenaria ursina*), Nevin's barberry (*Berberis nevinii*), ash-gray paintbrush (*Castilleja cinerea*), Vail Lake ceanothus (*Ceanothus ophiochilus*), southern mountain buckwheat (*Eriogonum kennedyi* var. *austromontanum*), Mexican flannelbush (*Fremontodendron mexicanum*), willowy monardella (*Monardella linoides* ssp. *viminea*), and spreading navarretia (*Navarretia fossalis*) have designated critical habitats. Designated critical habitat becomes final for San Diego thornmint (*Acanthomintha ilicifolia*) on September 26, 2008.

- In addition, critical habitat has been proposed for San Bernardino bluegrass (*Poa atropurpurea*) and California taraxacum (*Taraxacum californicum*). Further, Quino checkerspot butterfly (*Euphydryas editha quino*), San Bernardino kangaroo rat (*Dipodomys merriami parvus*), and Peninsular bighorn sheep (*Ovis canadensis*) have both designated and proposed critical habitats.

- Finally, for Coachella Valley milk-vetch (*Astragalus lentiginosus* var. *coachellae*) and San Jacinto Valley crownscale (*Atriplex coronata* var. *notatior*) our designation of critical habitat consisted of zero acres each, since all essential areas were excluded from critical habitat designation (71 FR 14538 and 70 FR 74111).

A-73-1

By regulation, "Fish hatcheries or wildlife management areas administered by the Secretary" are closed to leasing (43 CFR 3201.11).

On pages 2-6 and 2-7 of the Draft PEIS, there are a number of land types that may be closed to leasing. Specifically, under the proposed action, ACECs would be closed where the BLM determines that geothermal leasing and development would be incompatible with the purposes for which the ACEC was designed or that have management plans that expressly preclude new leasing or development.

For other sensitive areas (e.g., riparian areas and sensitive species habitat), stipulations are proposed to avoid, minimize, and mitigate any potential impacts.

This phased approach would not meet the stated purpose and need of facilitating geothermal leasing because the geothermal resource base for commercial development is concentrated, distinct, and localized.

A-73-2

The BLM supports the control of nonnative, invasive species. The Proposed Action provides a list of BMPs that could be applied as conditions of approval to subsequent permits to control invasive species for the particular site conditions.

Mitigation measures, including lease stipulations, conditions of approval, and the general operation of geothermal developments, would be monitored by the lessee or the appropriate Federal agency to ensure their continued effectiveness throughout all phases of development. Using adaptive management strategies, where mitigation measures are determined to be ineffective at meeting the desired resource conditions, the BLM and FS would take steps to determine the cause and would require the operator to take corrective action. This information would also be used to inform future geothermal leasing and development.

A-73-3

Additional discussion has been added to the cumulative impact analysis. As noted in Chapter 5, past, present, and reasonably foreseeable actions, including commercial uses of public and federal lands, are documented and analyzed.

Based on the analysis in Chapter 5 *Cumulative Impacts*, about 17 million acres of public land have commercial uses. Based on the reasonable foreseeable development scenario for geothermal development, by 2025 up to about 90,000 acres of federal land would be impacted by geothermal development. A typical geothermal electrical generation plant can disturb between 50 and 370 acres of land. Solar and wind facilities generally require 500 to 3,500 acres. Geothermal development will result in cumulative impacts to land, water, and other public lands uses, but the use is a fraction of the other uses on public lands and is relatively minor in scope compared to other uses.

A-73-4

Section 1.5.2 includes a list of areas statutorily unavailable for leasing and quotes from the regulations at 43 CFR 3201.11. Paragraph 3201.11 (e) excludes "…wildlife management areas administered by the Secretary." Since national wildlife refuge system lands are included in the above description, text has been added to Chapters 1 and 2 clarifying that lands managed by the National Wildlife Refuge System are closed to new leasing.

A-73-5

The Final PEIS has been corrected and the text has been revised as suggested by the comment.

A-73-6

Lands designated as closed and open in the CDCA follow the criteria listed on pages 2-6 and 2-7 of the Draft PEIS and the decisions within the management plans for the CDCA. The BLM is not proposing to amend the CDCA plans.

Decisions on siting and mitigation for any subsequent development will be assessed during the permit application process and would address the management areas provided in the comment. Any revisions of the CDCA plans would also address these management areas and their suitability for all types of developments.

A-73-7

The BLM is proposing to include a Sensitive Species Stipulation for leases in areas that have agency-designated sensitive species, including sage-grouse. The stipulation could be a NSO, CSU, or TL in order to meet resource objectives (Page 2-19 of the Draft PEIS). This approach provides the flexibility to respond to the dynamic national and regional planning and protection efforts for these species. During the permitting process for any subsequent drilling or development applications, the BLM would conduct the appropriate analysis on siting locations, as noted in the comment.

To provide further protection for threatened, endangered, and sensitive species, the BLM will impose an Endangered Species Act stipulation (see Section 2.2.2) on all geothermal leases.

A-73-8

As noted on pages 2-16 and 2-17 of the PEIS, the Proposed Action includes NSO and CSU stipulations specific to water bodies, riparian areas, wetlands, playa, and floodplains in order to avoid any subsequent development in these fragile areas. In addition, there are a number of BMPs (Appendix D) that could be applied as conditions of approval to future development permits to avoid or mitigate any impacts to these resources.

A-73-9

Additional lands do not have to be closed to provide protection for the species discussed in the comment.

Lands designated as open to leasing are subject to existing laws, regulations, and formal orders. In complying with these laws, regulations, and orders, some of the open lands may not be available for leasing. Chapter 2 explains, under *Procedures Prior to Leasing*, that the BLM and FS would comply with the requirements of the Endangered Species Act, including determining if any listed or proposed threatened or endangered species, or critical habitat, is present on nominated lease parcels and may be affected by any decision to lease. Chapter 6 of the FPEIS, in turn, explains that the agencies have determined that the decision to lease has no effect on listed species or critical habitat.

To provide further protection for threatened, endangered, and sensitive species, the BLM will impose an Endangered Species Act stipulation (see Section 2.2.2) on all geothermal leases.

A-73-10

The suggested change has been made.

A-73-11

Under the proposed action considered in the PEIS, the FS is not proposing to make any administrative or discretionary closures or to amend any land use plans. Prior to any leasing on NFS lands, the FS would have to provide consent. Through this process, the FS must identify specific lands that are administratively available and closed for leasing and under what conditions. This process will require environmental review, including NEPA documentation. Designating Critical Biological Zones on Forest Service lands would take place in the consent or land use plan amendment process. Pages 1-26 and 1-27 discuss the FS decisions resulting from the PEIS and required subsequent NEPA analysis.

A-73-12

Thank you for your comments. The measures have been added to Appendix D, BMPs, where they do not already exist. For migratory birds (including burrowing owls), measures are already included. They are also present for raptors.

A-73-13

General impacts to wildlife resulting from habitat fragmentation are discussed on page 4-78. A complete discussion of the potential impacts on wildlife from all aspects of geothermal leasing and development are found on pages 4-74 through 4-92.

A-73-14

Thank you for your comment. The recommended change has been made.

A-73-15

Text has been added on the consultation process.

In Chapter 2, under *Procedures Prior to Leasing*, it is noted that the BLM and FS would determine if any listed or proposed threatened or endangered species, or critical habitat, is present on nominated lease parcels to comply with the Endangered Species Act.

A-73-16

In Chapter 2, under *Procedures Prior to Leasing*, it is noted that the BLM and FS would determine if any listed or proposed threatened or endangered species, or critical habitat, is present on nominated lease parcels and would comply with the Endangered Species Act prior to issuing the lease. Any potential impacts to site-specific hydrology and species would be addressed as part of the ESA evaluation.

A procedure prior to leasing has been added as follows:

> The authorized officer of the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states manage and typically have regulatory authority for water quality, water rights, and wildlife. During the environmental review for any subsequent permit applications for drilling or development, the BLM and FS would conduct the necessary environmental review and analysis based on the proposed site development and technology. Such location- and technology-specific information is critical to assess localized resources like hydrology and groundwater. BMPs are provided in Appendix D and could be applied as conditions of approval to permits. The list is not inclusive and could be expanded by the BLM and FS to address site-specific conditions.

A-73-17

The comment has been noted. The analysis in Chapter 4 is commensurate with the scope of the proposed action for the PEIS. Prior to leasing, the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states typically manage and have regulatory authority for water quality, water rights, and wildlife.

This document does predict a general level of anticipated future geothermal development in BLM areas that have geothermal potential, but it is not intended to provide full analysis of all phases of development. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis.

A-73-18

These species have been added to the document as requested. Coordination with the USFWS would occur as part of the NEPA process prior to any exploration or development.

A-73-19

Appendix A has been revised.

A-73-20

Appendix A has been revised.

A-73-21

As described in Section 2.2.1 *Lands Identified for Leasing*, ACECs will be closed to leasing where the BLM determines that geothermal leasing and development would be incompatible with the purposes for which the ACEC was created, or where management plans preclude new leasing or development for oil and gas or geothermal resources. Data for ACECS closed or open to leasing presented in Appendix C was provided by BLM state offices and may not represent the comprehensive list. The ACECS list on the website provide by the commentor does not include stipulations or indicate if ACECs are closed or open to oil and gas and or geothermal leasing; therefore, these areas were not added to the appendix.

A-73-22

The comment is noted. A separate section for threatened and endangered species has been added to Appendix D.

A-73-23

The suggested change has been made.

A-73-24

Changes made to the BMPs include the control of pets. In regards to disruption of wildlife during breeding, it is not possible to avoid all disturbance of all wildlife during all reproductive seasons. Measures are already included to protect migratory birds, big game, and special status species during important reproductive, calving, and courting periods.

A-73-25

The recommended change has been made to the document.

A-73-26

Thank you for providing the list. The conservation measures are very helpful. Given the specific nature of the conservation measures, they have not been included specifically. In Chapter 2 under *Procedures Prior to Leasing*, it is noted that the BLM and FS would determine if any listed or proposed threatened or endangered species, or critical habitat, is present on lease parcels and would comply with the Endangered Species Act prior to issuing the lease. In addition, at the time projects are proposed, additional measures may be developed through consultation, as appropriate.

A-73-27

Changes have been made to the document. The inappropriate BMPs have been removed, and measures for monitoring have been added.

A-73-28

Thank you, all changes have been made to the table.

September 19, 2008

Delivered via electronic mail to: geothermal_eis@blm.gov and hard copy U.S. post

Draft Geothermal Leasing PEIS
c/o EMPSi
182 Howard Street, Suite 110
San Francisco, CA 94105-1611

Re: Scoping Comments on the Draft Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States, May 2008.

To Whom It May Concern:

We appreciate the opportunity to respond to and offer input on the U.S. Forest Service and Bureau of Land Management Programmatic Environmental Impact Statement (PEIS) for agency-wide geothermal energy programs and policy. Enclosed are our scoping comments submitted jointly on behalf of the Citizens for San Luis Valley Water Protection Coalition and San Luis Valley Ecosystem Council.

Our organizations serve the Upper Rio Grande River basin including the headwaters and greater San Luis Valley, CO. The San Luis Valley (SLV) is the world's largest semi-alpine Valley. Roughly 122 miles long and 74 miles wide, the 8,100 mile^2 SLV contains six rural Colorado counties; Saguache, Alamosa, Rio Grande, Conejos, Costilla and Mineral Counties. Over 71% of the SLV is public land including much of the 1.86 million acre Rio Grande National Forest, San Luis District of the Bureau of Land Management, the Great Sand Dunes National Park and the Alamosa, Monte Vista and Baca National Wildlife Refuges.

The Citizens for San Luis Valley Water Protection Coalition (WPC) is a grassroots organization representing a broad spectrum of interests. It's members are united by the belief that the vital ecological, wildlife, cultural, agricultural and water resources of the upper Rio Grande and Closed Basins of the SLV should not be jeopardized by destructive industrialization of any kind. By working with communities, local government and various stakeholder groups, WPC is actively engaged in developing an SLV Citizens Energy Initiative that is responsive to the demands of climate change while protecting the vital natural and cultural resources are the foundation of our communities.

The mission of the San Luis Valley Ecosystem Council (SLVEC) is to protect and restore - through research, education and advocacy - the biological diversity, ecosystems, and natural resources of the upper Rio Grande bioregion, balancing ecological values and human needs. On behalf of more than 4,500 supporters, SLVEC has worked extensively with Federal agencies (including the US Forest Service and Bureau of Land Management) to identify priorities, make recommendations and develop prescriptions for travel management and vegetation, watershed, wetland, wildlife habitat and corridors, and cultural and Natural Heritage Program sites using a GIS/landscape-level approach.

The SLV is rapidly emerging as a major focal point for renewable energy generation development in the region. As federal, state and regional energy policies evolve, we expect the unique biogeography of the SLV to place us squarely in the middle of the new energy economy.

We support taking immediate action to limit and even reverse dangerous levels of carbon emissions and greenhouse gases. Our dependency on fossil fuels is undeniably jeopardizing global climate systems and the need to transform our energy economy is urgent. Such an energy transformation offers a tremendous opportunity to start anew and avoid mistakes of past energy policies. With ecosystem processes being taxed to an extreme and biological diversity collapsing as a result of our unwise resource use, the relatively pristine, intact ecosystems still extant in the SLV are priceless and constitute vital life and economic sustaining resources for our region and beyond. We urge the USFS and BLM to work in partnership with public lands advocacy organizations such as ours to ensure that issues of scale, siting and water demands of geothermal plants on or near public lands in the SLV are resolved efficiently and affectively.

Colorado was assessed for its geothermal energy potential in the late 1970s and early 1980s. Many low and moderate temperature resources suitable for direct use applications were found, but no conclusive evidence of a high temperature resource that could be used for electrical power generation was identified. The 2006 Western Governors Association report ranked Colorado fourth among western states in the number of potential sites for geothermal power generation. New technologies and methods of assessing geothermal resources such as the use of velocity of seismic P-waves are currently being applied and indicate that high elevation geological active zones, such as those found in central and southern Colorado may emerge as some of the best geothermal sources in the West.

Colorado exhibits high heat flow, volcanism, recent faulting and continental rifting – geologic features considered indicative of geothermal resources with power generation potential. The Rio Grande rift zone extends along both sides of the SLV. According to the Colorado Geothermal Development Strategic Plan (2007), the San Luis Basin has "large potential resources ranging from low temperature at intermediate depths (2,000-4,000 ft) to above-boiling temperatures at deep depths (7,000-9,500 ft)", (see attachment A). A recent MIT study (2006) described the northern Rio Grande Rift extending into the SLV as having "probably the highest basement Enhanced Geothermal System (EGS) potential on a large scale." The Western Governors' Geothermal Task Force identified Colorado as having the potential for 20MW of power generation within a decade and they are in the process of updating their geothermal database and evaluating potential geothermal energy sources in response to the States renewable energy portfolio standard (Matthews, 2007).

While we support the development of geothermal energy production as a much more desirable and appropriate energy solution for the SLV than traditional fossil fuel development, we are concerned that intensified, industrial-scale development could jeopardize the broader environmental values, in particular the extensive but fragile aquifers that underlie these values, that we, and the citizens of the SLV have worked long and hard to protect.

The SLV is uniquely suited to serve as a 'pilot study' area for balanced alternative energy development, where appropriate scale technologies enhance rather than overwhelm existing natural and cultural systems, and strengthen and diversify rather than dominate local economies. Collectively, we have decades of experience promoting Valley-wide initiatives, public awareness and citizen action, problem solving and planning processes addressing a wide-range of issues of concern to the bioregion. The SLV was chosen for a US Environmental Protection Agency Pilot Study on regional sustainability (EPA Office of Research and Development, Cincinnati, Ohio). As a natural outgrowth of our work, we have initiated a SLV Citizens Energy Initiative (CEI) with the goal of establishing a regional model for renewable energy development.

Stakeholder participation is important at this early stage of development, and will continue to be for years to come and the CEI will be a powerful vehicle for stakeholder input. As organizations with long-standing and proven successes in community education and organizing around environmental issues, and extensive knowledge and involvement in important water, public lands and resource use issues in the Valley, we invite USFS and BLM to collaborate with us in developing the CEI and the PEIS as they move forward.

We welcome the opportunity to serve as an active stakeholder in creating a model for the future that embraces both the need for new energy solutions and rigorous protection of our fragile ecosystems. We believe in a future where energy production and protection of our fragile ecosystem processes go hand-in-hand.

We are submitting these comments today via electronic mail and also forwarding a copy with attachments to you separately. Thank you for considering these scoping comments and for your collective commitment to supporting responsible renewable energy development. We look forward to continuing to participate with you in this process.

Sincerely,

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Scoping Comments on the Geothermal Energy Programmatic Environmental Impact Statement submitted jointly by the San Luis Valley Ecosystem Council and the Citizens for San Luis Valley Water Protection Coalition

I. Large-scale Geothermal Energy Leasing Requires Development of a Thoughtfully Designed Approach

A. The risks and unknowns specific to geothermal energy development require caution before rushing into a large-scale program

According to the Energy Information Association, there are currently roughly 2,400 megawatts (MW) of installed geothermal electricity generation in the western United States, less than 1% of total U.S. generation capacity. The Reasonably Foreseeable Development Scenario (RFD) for the Draft PEIS forecasts that within the planning area, 12,100 MW of geothermal potential are considered viable for commercial electrical generation from 242 power plants by 2025; the RFD further estimates direct use applications of 4,200 thermal MW by 2025. Such massive development of geothermal resources will no doubt have significant impacts to the public lands and their many resources. We believe development predicted on this scale warrants careful studies of the impacts to public land, water (especially aquifers), wetlands, wildlife and other affected natural resources prior to finalizing the PEIS and approval and issuing specific leases.

While significant development of flash steam power plants has allowed analysis of impacts from this indirect use of geothermal resources, most of the geothermal power plants planned for construction in the U.S. are binary-cycle. Though impacts from binary-cycle plants do not appear to be radically different from flash steam plants, additional technologies are being developed that will require much greater analysis before their impacts can be understood. In particular, "co-produced geothermal fluids," also known as "produced water cut", and "enhanced geothermal systems" are emerging technologies whose impacts are relatively unknown. Development of these resources should not be done without close examination of potential risks and impacts, and if development does occur it should be done slowly, in a phased manner, to ensure ongoing study can identify and fix problems and issues that arise.

For new technologies such as enhanced geothermal systems, a cautious approach emphasizing monitoring and phased development is critical. Though the Draft PEIS states that, "It is anticipated that there may be applications for research and development drilling on public and NFS lands in the future. While it is a viable and proven technology, it is unlikely that it will be applied at a large scale in the western US within the next 20 years," (Draft PEIS 1-9), this technology has not been thoroughly tested in the US and requires further investigation to ensure that unacceptable impacts are avoided, especially in geologically complex and poorly understood areas like the Rio Grande Rift complex in the San Luis Valley. 0-74-1

While Chapter 4 of the Draft PEIS examines the general types of impacts expected from geothermal development, the inability to predict future development scenarios, including types of development, timing, location and risks will require additional site-specific analysis *prior to* leasing lands for project development.

Recommendations: Due to the projected scale of geothermal development and relative lack of knowledge of the impacts of such development, the agencies should approach geothermal development on public lands in a measured manner. We recommend that a pilot project be developed and operated for a sufficient time period to yield a more complete understanding of unforeseen problems, impacts and best management practices unique to the Rio Grande Rift before permitting private utility geothermal projects in the SLV. Beyond this, we recommend phased development and monitoring to ensure that impacts are well studied and, where avoidable, effective mitigation measured developed. Avoidance of negative impacts should, of course, be a priority. Where new and developing technologies are being proposed, research and development should be undertaken with caution and large-scale deployment of new technologies should only be done after thorough analysis. We strongly recommend that BLM work closely with local government entities and citizen groups to carefully plan and implement projects in accordance with the *SLV Citizens Energy Initiative* before consideration of large-scale or multi project leasing in the San Luis Valley.

B. Geothermal development is not always renewable: water use of certain geothermal development systems demands in-depth analysis.

Because of water use, certain types of geothermal development are not "renewable" in the way that other renewable energy sources are. The Draft PEIS acknowledges that for flash steam facilities, "about 15-20 percent of the fluid would be lost due to flashing to steam and evaporation through cooling towers and ponds." (p. 2-47). The Draft PEIS further addresses these impacts in Chapter 4, stating that potential impacts on water resources could occur if reasonably foreseeable actions were to result in "Substantially depleted groundwater supplies or interfered substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater 0-74-2 table level;" or "Resulted in changing conditions so that the geothermal resource itself was degraded." (p. 4-40). During drilling operations,

> **Extracting geothermal fluids could result in drawdowns in connected shallower groundwater aquifers, with the resulting potential to affect streams or springs that are connected to the water table aquifer.** The potential for these types of adverse impacts is reduced through extensive aquifer testing, which is the basis for designing the geothermal plant and for locating, designing, and operating the extraction and injection wells. Combined with the requirement to comply with state and federal regulations that protect water quality and with limitations imposed by water rights issued by the state engineer, the impacts on water quality and the potential for depleting water resources is expected to be minimized. **There is a medium risk for moderate to high impacts on groundwater supplies from the use of groundwater for geothermal activities** (p. 4-43) (emphasis added).

During utilization,

> Geothermal resource utilization could affect groundwater resources because of consumption of water by evaporation and the need to reinject water to replenish the geothermal reservoir. The magnitude of the effects would vary depending on groundwater conditions and availability within the basin and on the type of geothermal plant. Availability of water resources could be a limiting factor, affecting the expansion of geothermal resource development in a given area (p. 4-44).

The Draft PEIS further states that, "withdrawing shallow groundwater or surface water for cooling purposes could affect nearby springs." (p.4-45).

Clearly, flash cycle plants have significant potential for depleting the water that is a critical component of the geothermal resource, limiting the "renewable" nature of this development. Further, all geothermal development has the potential for impacts to surface and groundwater quality and quantity, and analysis and mitigation must focus on limiting these impacts.

Recommendation: The Closed Basin confined and unconfined aquifer system is one of the most complex and poorly understood aquifer systems in the state. Protracted water wars have led to a number of Federal, state and local water protection statutes that must be considered in light of geothermal development in the SLV. While we are not suggesting that geothermal be completely removed from consideration in the SLV, it should be in context to the relative value of renewable resources in the region. The SLV is rated as fifth nationally and first in the state for its solar energy generation potential. Given the considerable conflicts that geothermal development presents with traditional agriculture and water users, agencies should prioritize renewable solar development over geothermal development, where depletion is a cognizable risk. The BLM and Forest Service should also prioritize binary cycle geothermal development over flash steam development to reduce the risk of depleting geothermal resources. The PEIS should specifically require additional site-specific analysis of potential impacts to geothermal and water resources of individual lease and project proposals and, in the SLV, require compatibility with the SLV Citizens Energy Initiative.

The following specific concerns need to be considered before approval of geothermal leasing in the San Luis Valley:

C. Ground Water Use and Protection of the Closed Basin Aquifer

The MIT study concluded that "the major environmental issues for EGS are associated with ground-water use and contamination" (1-27). Because of the presence of the confined and unconfined Closed Basin aquifer in District 3, these concerns are of paramont importance in the SLV. Below are some specific legal, political and environmental statutes and concerns that require serious consideration before leasing Federal lands for geothermal in the SLV:

A. Colorado water rights, rules and stipulations;
B. Cumulative affects on aquifer depletion;
C. Protection of significant aquifer recharge areas (stream runoff areas, wetlands, artisan wells, etc.); 0-74-3
D. Rio Grande Compact conflicts;
E. Compliance with federal, state, and county water use statutes, regulations and rules, specifically, but not limited to;
   1. The Great Sand Dunes National Park and Preserve Act of 2000. A unique aspect of this legislation, outlined in Section 6, is its adoption to specifically protect the unique hydrogeology which supports the Great Sand Dunes formation;
   2. Colorado 98-1011 authorizing the Rio Grande Decision Support System (RGDSS) Study. Among other things, the RGDSS created the scientific framework for Colorado State Law 04-222 by establishing the

geo-hydrological context for regulating water allocation in Water District 3 based on the finite nature of the Closed Basin aquifer system.)

3. Colorado State Law 04-222, "Rules Governing New Withdrawals of Groundwater in Water Division 3 Effecting the Rate or Direction of Movement of Water in the Confined Aquifer System". Promulgated pursuant to the authority granted to the State Engineer in section 37-90-137 (12)(b)(I), C.R.S. (2003), and section 37-92-501, C.R.S. (2003) as amended by Senate Bill 04-222. *"These rules have as their objective the optimum use of water consistent with preservation of the priority system of water rights and protection of Colorado's ability to meet its interstate compact obligations…allowing fluctuations in the artesian pressures in the Confined Aquifer within the ranges that occurred during the period of 1978 through 2000, and allowing artesian pressures to increase in periods of greater water supply and to decline in periods of lower water supply in much the same manner and within the same ranges of fluctuation as occurred during the period of 1978 through 2000, while maintaining average artesian pressure levels similar to those that occurred in 1978 through 2000."*
4. The Land Use, Master Planning and 1041 Codes and Regulations of the six counties comprising the San Luis Valley. In particular, Saguache County's Land Development Code, Article XVIII "Significant Groundwater Recharge Zones"; adopted to "*…regulate identified areas designated as significant groundwater recharge zones, to prevent immediate or foreseeable degradation of quality to the ground water and/or connecting subsurface water, surface water, flood plains, wet lands, or riparian areas. To prevent material impact to aquatic life, wildlife, agricultural, and the health, safety and welfare of Saguache County residents…to otherwise plan for and regulate the use of land overlying ground water recharge zones so as to provide for planned and orderly use of land and protection of the environment and health, and safety and welfare of Saguache residents in a manner consistent with Federal, State and County regulations";*
5. Renewable energy regulations currently enacted or under consideration in any of the six counties of the San Luis Valley;
6. Reinjection. Due to over appropriation of the confined aquifer in the San Luis Valley, the Colorado Division of Water (CDW) the surface disposal of geothermal fluids augmentation is not allowed. Geothermal projects will have to include re-injection wells, even for shallow and warm direct use applications. Additional hydrogeological consultation with experts in the Closed Basin aquifer will be needed to establish the appropriate depth to which geothermal spent fluids should be re-injected in order to avoid disruption of essential hydrologic processes. DWR regulations for drilling Type A and Type B geothermal wells will require additional information that will require an initial exploration well, in addition to the production and re-injection wells.
7. Geohazards. The same attributes that make the SLV a prime area for geothermal energy generation also bring high geohazard risks. The MIT study specifically sites concerns about induced seismicity or subsidence "as a result of water injection and production" (1-27). The geologically young Rio Grande Rift runs along both sides of the San Luis Valley. Its hydrogeological relationship with the aquifers of the Closed Basin is complex and not well understood. The Rift resulted from a process of regional extension and mantle upwelling in Neogene times (beginning 29 million years ago), and continues to widen today. Ongoing geologic activity is evident through high heat flow, hot springs, continued seismicity, geodetic observations, and some of North America's most recent lava flows (Veatch, 1998). Geothermal development employs the same fracturing techniques used for oil and gas development. Additionally, the highest temperature geothermal resources occur at depths of up to 10,000 meters. Given the volcanic and seismic history of the area, there are concerns that significant underground explosions/disturbances could induce unintended seismic activity and result in large-scale damage to a wide array of resources. Potential geohazards, in particular induced seismicity and subsidence need to be analyzed and thoroughly assessed, and in-depth, site-specific studies completed as part of any comprehensive geothermal facility siting process.

D. Geothermal leasing and development should not be implemented in the same way as oil and gas leasing and development

The Draft PEIS repeatedly mentions the perceived similarities between oil and gas drilling and geothermal development and the intent of the agencies to rely on their experience with oil and gas development for fashioning their approach to managing geothermal energy development. The Draft PEIS states:

> BLM and FS have had a great deal more experience managing lands for development of oil and gas resources, and many more management plans address these resources. Development of oil and gas resources result in many of the same kinds of impacts as development of geothermal resources (e.g., surface disturbance resulting from the footprints of facilities, wells, pads and pipelines, as described in Section 2.5, Reasonably Foreseeable Development Scenario); therefore, BLM and FS have determined that it is appropriate to take an approach to development of geothermal resources similar to that taken to development of oil and gas resources. Areas that require protection from the effects of development of fluid resources are more likely to require protection from the similar effects of development of geothermal resources (p. 2-6). 0-74-4

Although similarities exist in the development and impacts of developing geothermal energy and oil and gas, there are also fundamental differences and opportunities. As discussed above and throughout these comments, the technologies used and still in development for geothermal energy often require significant amounts of water and can have different effects than oil and gas drilling. Also, while development of these energy sources can cause significant damage to other resources, such as wilderness qualities, wildlife, water, vegetation, and recreation opportunities, the agencies have already made major commitments to oil and gas leasing, and seen the devastating results to the public lands.

The BLM and Forest Service should take the opportunity offered by this programmatic document and subsequent analysis to avoid the mistakes of the oil and gas program. Significant problems have beset the oil and gas program, including: inappropriate prioritization of leasing and drilling over all other resources and values; lack of adequate impacts analysis; failure to use the best available scientific research to inform management; insufficient monitoring and mitigation of impacts; inadequate leasing stipulations and Best Management Practices (BMPs) to protect other resources; abuse of exceptions and waivers from stipulations and BMPs; failure to employ true phased development; and inadequate bonding and reclamation. The failure to work with local government and communities, carefully plan, consider impacts and avoid damage to other resources and users of the public lands has resulted in serious conflict and devastating impacts to the public lands, as well as negative impacts to our economy and public health and considerable expense both to the federal government, ecological systems, biodiversity values and public health.

Geothermal development offers the opportunity to increase our national energy supplies while limiting greenhouse gas emissions and subsequent impacts from climate change. However, if the agencies do not learn from and avoid a repeat of the mistakes of the oil and gas program, any potential benefits could be outweighed by the recurrence of the problems listed above. BLM should instead adopt a cooperative measured approach that maximizes the benefits of geothermal development while limiting impacts to other resources and values. This PEIS provides an important opportunity to design a thoughtful approach to geothermal leasing and development that avoids the mistakes of the past.

Recommendation: BLM should adopt a cooperative measured approach to geothermal development, taking into consideration the unique aspects of geothermal development and avoiding the problems of the oil and gas program in order to maximize the benefits of geothermal development while minimizing conflicts with other stakeholders, communities and impacts to other resources and values.

E. Geothermal development should be conducted to achieve a net decrease in greenhouse gas emissions and related impacts from climate change

The development of renewable energy sources, including geothermal, offers the opportunity to limit damaging impacts from climate change by displacing electricity production from fossil fuels and thus reducing greenhouse gas emissions. As stated in the Draft PEIS:

> "A study comparing greenhouse gas emissions from electrical generation using fossil fuels and geothermal fluids found that geothermal produces an order of magnitude less in carbon dioxide, hydrogen sulfide, methane, and ammonia (Bloomfield *et al.* 2003)" (p. 1-20).

> "Direct use of geothermal resources, such as using geothermal to heat buildings, has the potential to displace 18 million barrels of oil per year (WGA 2006). Increased geothermal energy utilization could help the US reduce greenhouse gas emissions and meet policy goals (Bloomfield *et al.* 2003)." (p. 1-20). O-74-5

We support the BLM's recognition of the importance of analyzing the effects of its action on climate change. Global climate change is now acknowledged to be a major consideration for effects of major federal actions. The Supreme Court has concluded that "[t]he harms associated with climate change are serious and well recognized." *Massachusetts v. E.P.A.*, 127 S.Ct. 1438, 1455 (2007). Further, the Supreme Court has held that while agency action may not completely reverse the effects of climate change, it does not relieve the agencies of the responsibility to take action to reduce it. Id. at 1458. In fact, an order issued by the Secretary of the Interior requires that:

> Each bureau and office of the Department will consider and analyze potential climate change impacts when undertaking long-range planning exercises, when setting priorities for scientific research and investigations, when developing multi-year management plans, and/or when making major decisions regarding the potential utilization of resources under the Department's purview.

U.S. Dept. of the Int., Sec. Order No. 3226 (Jan. 19, 2001), Section 3.

While there are many anticipated benefits to geothermal energy production over fossil fuels, the PEIS must address the potential for geothermal energy to have adverse impacts on climate change. For example, many western landscapes are already becoming increasingly fragile due to global climate change. In addition, these landscapes have important value as carbon "sinks," which could be lost if they are developed.[1] Further, undeveloped land has value as potential habitat as wildlife migrates to respond to climate changes. The destruction of these lands for geothermal energy production would thus contribute to the negative impacts of climate change.

Though the Draft PEIS does address impacts to air quality and climate from geothermal development, it does so only in the context of comparisons between geothermal development and fossil fuels development. The PEIS should further analyze negative impacts to climate change from geothermal development and seek to mitigate negative impacts on climate change through the designation of appropriate lands open to geothermal energy development and lease stipulations and BMPs to limit negative impacts. An additional factor to consider is whether fossil fuels will be transmitted on lines designated for geothermal energy.

The agencies must analyze net impacts of geothermal energy development on climate change and include consideration of landscapes and wildlife that already are or have the potential to be affected by climate changes. The BMPs incorporated into this PEIS should include practices to mitigate potential climate change impacts.

Because geothermal development does result in some greenhouse gas emissions, the agencies should weigh also geothermal development against other forms of renewable energy development such as wind and solar. Though wind and solar development can also have negative impacts on climate change due to impacts to carbon sinks, wildlife habitat, and migration corridors, they create almost no greenhouse gas emissions (http://www.sciam.com/article.cfm?id=a-solar-grand-plan). The agencies should analyze climate change impacts of geothermal development in the context of these other renewable energy sources, particularly solar, and prioritize whichever type of development that results in the greatest net benefit.

Cumulative Impacts. Being the most northeasterly source of quality solar energy in the nation, the SLV has become a focal point for utility-scale solar energy development. It is critical that geothermal development be assessed in this context and that **cumulative impacts be analyzed for all renewable energy initiatives being considered now or in the foreseeable future for the entire SLV, including private and other non-federal lands.** A cumulative impact assessment must include, at the least, effects on aquifer and surface water resources, wetlands, essential ecological processes, wildlife habitat and corridors, sensitive species (including state listed), noise, economic, cultural resources, visual, pubic safety and land use.

Recommendations: The agencies should manage geothermal development on the public lands in a manner that will result in a net benefit to climate change. The PEIS should analyze climate impacts of geothermal development in the context of both the negative impacts to carbon-sinks and wildlife habitat and migration corridors, as well as the positive impacts in displacing fossil fuels electricity production. The PEIS should also weigh geothermal development against other renewable energy development and prioritize whichever type of development that results in the greatest net benefit, taking into account relative need for water or use of geothermal resources. Further, the PEIS should require similar analyses of proposed leasing and projects at a site-specific level.

II. The Proposed Action Is Not Sufficient to Protect the Resources which the Agencies Are Charged with Managing.

A. The agencies must consider a more protective range of alternatives.

NEPA mandates consideration of a full range of alternatives. The range of alternatives is "the heart of the environmental impact statement." 40 C.F.R. § 1502.14. NEPA requires BLM to "rigorously explore and objectively evaluate" a range of alternatives to proposed federal actions. *See* 40 C.F.R. §§ 1502.14(a), 1508.25(c).

> NEPA's requirement that alternatives be studied, developed, and described both guides the substance of environmental decision-making and provides evidence that the mandated decision-making process has actually taken place. Informed and meaningful consideration of alternatives -- including the no action alternative -- is thus an integral part of the statutory scheme.

O-74-6

Bob Marshall Alliance v. Hodel, 852 F.2d 1223, 1228 (9th Cir. 1988), cert. denied, 489

[1] *See, e.g., Have Desert Researchers Discovered a Hidden Loop in the Carbon Cycle?,* Science, Vol. 320, pp. 1094-140 (June 13, 2008) (attached).

U.S. 1066 (1989) (citations and emphasis omitted).

"An agency must look at every reasonable alternative, with the range dictated by the nature and scope of the proposed action." *Nw. Envtl. Defense Center v. Bonneville Power Admin.*, 117 F.3d 1520, 1538 (9th Cir. 1997). An agency violates NEPA by failing to "rigorously explore and objectively evaluate all reasonable alternatives" to the proposed action. *City of Tenakee Springs v. Clough*, 915 F.2d 1308, 1310 (9th Cir. 1990) (quoting 40 C.F.R. § 1502.14). This evaluation extends to considering more environmentally protective alternatives and mitigation measures. *See, e.g., Kootenai Tribe of Idaho v. Veneman*, 313 F.3d 1094,1122–23 (9th Cir. 2002) (and cases cited therein).

NEPA requires that an actual "range" of alternatives is considered, such that the Act will "preclude agencies from defining the objectives of their actions in terms so unreasonably narrow that they can be accomplished by only one alternative (i.e. the applicant's proposed project)." *Col. Envtl. Coal. v. Dombeck*, 185 F.3d 1162, 1174 (10th Cir. 1999), citing Simmons v. U.S. Corps of Engineers, 120 F.3d 664, 669 (7th Cir. 1997). This requirement prevents the environmental impact statement (EIS) from becoming "a foreordained formality." *City of New York v. Dep't of Transp.*, 715 F.2d 732, 743 (2nd Cir. 1983). *See also Davis v. Mineta*, 302 F.3d 1104 (10th Cir. 2002).

For this PEIS, the broad scope of the proposed action requires a broad range of alternatives. However, the Draft PEIS currently considers only two actual alternatives: the proposed alternative, Alternative B, for leasing on a broad scale and another, Alternative C, for more limited leasing based on existing transmission lines. The Draft PEIS itself states that Alternative A is not an alternative but rather a baseline against which to compare the two action alternatives. Draft PEIS, p. 2-30. This range is insufficient.

Recommendations: The PEIS should incorporate aspects of both alternatives into a broader range and expand the conservation emphasis in the range of alternatives; many additional conservation measures that are within the range between "no leasing" (Alternative A) and making the majority of lands available for leasing (Alternative B) are discussed below and should be included for consideration and in the selected alternative. In the San Luis Valley, we recommend that the agencies prioritize projects in close proximity to the 31 existing substations and two major transmission lines before considering projects that are outside of energy corridors. Also, instead of simply evaluating lease applications as received, the agencies could give priority to projects that are in non-controversial locations, have already completed a robust environmental analysis and mitigation plan, and/or sited near the existing substations or planned corridors. The agencies could also phase leasing based on the most well documented geothermal resources and limit the amount of leasing based on protecting wildlife habitat and other uses. Buffers around existing geothermal resources on lands that are protected from leasing should also be incorporated. As discussed above, we strongly recommend establishment of a research and development pilot project in the SLV before authorizing other projects.

B. The proposed action, Alternative B should not be adopted, because it formally makes the majority lands available for leasing and development without sufficient analysis or protections.

Alternative B would make 117 million acres of BLM land and 75 million acres of Forest Service land open to geothermal leasing for direct and indirect use, a total of 192 million acres comprising approximately 77% of the planning area. Draft PEIS, p. 2-7. The Draft PEIS refers to the agencies' discretion in deciding whether to issue leases, but Alternative B does not provide a reasoned approach for exercising this discretion to ensure the best use of our public lands. The decision would be made without sufficient protection for other natural values, such as wilderness characteristics and other recreational or scientific use of geothermal resources. Further, Alternative B would only provide a limited buffer around the geothermal resources in Yellowstone National Park, based on areas that are already protected by a non-discretionary closure (as opposed to the 15 miles in Alternative C). Draft PEIS, p. ES-6. Alternative B also does not encompass practical considerations, such as the availability of transmission, existing or planned, for development.

O-74-7

The Draft PEIS analogizes to the structure of oil and gas leasing. *See, e.g.*, Draft PEIS, pp. 2-6 – 2-7. In the context of oil and gas leasing, issuance of a lease is considered an irretrievable and irreversible commitment of federal resources and, unless issued with a "no surface occupancy" stipulation, cannot be presumed to allow the agencies to retain control to prohibit damage to the environment. *See, e.g., Bob Marshall Alliance v. Hodel*, 852 F.2d 1223, 1227 (9th Cir. 1988); *Pennaco Energy v. U.S. Dept. of Interior*, 377 F.3d 1147, 1160 (10th Cir. 2004). Accordingly, it is important that allocations of land as open to leasing be based on thorough environmental review, in addition to providing for sufficient site-specific analysis to occur prior to leasing. Because the Draft PEIS specifically states that projects can be tiered to the PEIS and not all development will warrant additional environmental analysis, the PEIS must critically analyze the lands that it designates as open to leasing, which requires inventorying the area for wilderness and roadless characteristics and protecting those places with valuable and vulnerable resources. Alternative B does not include sufficient commitments to inventory or to apply protective measures.

Recommendation: The PEIS should not adopt Alternative B.

C. Additional elements required for an approach to be adopted in the PEIS.

Alternative C includes significant improvements from Alternative B. This alternative would still make approximately 92 million acres of land available for leasing for commercial transmission. Draft PEIS, p. ES-6. However, there would be a protective 15-mile buffer around the boundary of Yellowstone National Park and leasing would be confined to a 20-mile corridor (10 miles from centerline) from existing transmission lines and those under development, with protective management prescriptions. *Id.* Nonetheless, Alternative C fails to protect additional valuable places and resources that are at risk of damage or destruction if leased for geothermal development. O-74-8

In order to protect these values, the PEIS must:

1. Expand categories of lands that are closed to leasing.

We agree with the agencies' assessment of categories of certain lands as closed to geothermal leasing, including Wilderness Areas, Wilderness Study Areas, National Conservation Areas, Wild and Scenic Rivers, National Recreation Areas, and other special management areas. However, there are other important areas that must be excluded from geothermal leasing and development.

a) Forest Service Inventoried Roadless Areas

The Roadless Area Conservation Rule mandates no new road construction or reconstruction in inventoried roadless areas. *See*, 66 Fed. Reg. 3243, 3270 (January 12, 2001). Further, the Draft PEIS acknowledges that the need for road construction and maintenance for exploration, drilling and utilization phases of geothermal energy development. *See, generally*, Draft PEIS, pp. 2-40 - 2-46. Accordingly, since these lands cannot be developed in accordance with the Roadless Rule, they should not be made available for leasing. O-74-9

b) Lands with wilderness characteristics

The Draft PEIS states:

> BLM has the authority to address lands with wilderness characteristics and describe protective management prescriptions in RMPs. In keeping with the public involvement process that is part of all land use planning efforts, the BLM will consider public input regarding lands to be managed to maintain wilderness characteristics.

Draft PEIS, 1-25. We appreciate the BLM's acknowledgment of its authority and commitment to public participation in managing lands to protect wilderness characteristics. Since the PEIS will amend as many as 122 land use plans and many RMPs will not be revised for years after the PEIS is finalized, the inventory and protective management of lands with wilderness characteristics should occur as part of this planning process.

Pursuant to FLPMA, "The Secretary shall prepare and maintain on a continuing basis an inventory of all public lands and their resource and other values (including, but not limited to, outdoor recreation and scenic values), giving priority to areas of critical environmental concern. This inventory shall be kept current so as to reflect changes in conditions and to identify new and emerging resource and other values." 43 U.S.C. §1711(a). Wilderness character is a resource for which BLM must keep a current inventory. As the U.S. Court of Appeals for the Ninth Circuit recently held: "wilderness characteristics are among the 'resource and other values' of the public lands to be inventoried under § 1711. BLM's land use plans, which provide for the management of these resources and values, are, again, to 'rely, to the extent it is available, on the inventory of the public lands, their resources, and other values.' 43 U.S.C. § 1712(c)(4)." *Oregon Natural Desert Ass'n v. Bureau of Land Management*, 531 F.3d 1114, 1119 (9th Cir. 2008). Therefore, BLM is required to consider "whether, and to what extent, wilderness values are now present in the planning area outside of existing WSAs and, if so, how the Plan should treat land with such values." *Id.* at 1143. O-74-10

BLM has identified "wilderness characteristics" to include naturalness and providing opportunities for solitude or primitive recreation. *See* Instruction Memoranda 2003-274, 2003-275, Change 1. These values are to be *identified and protected* in the land use planning process. *See* BLM Land Use Planning Handbook (H-1601-1, 2005); *Oregon Natural Desert Ass'n v. Bureau of Land Management, supra.* Further, BLM's national guidance provides for management that emphasizes "the protection of *some or all* of the wilderness characteristics as a priority" over other multiple uses. (emphasis added). This guidance does not limit its application to lands suitable for designation of Wilderness Study

Areas; for instance, the guidance does not include a requirement for the lands at issue to generally comprise 5,000-acre parcels or a requirement that the lands have *all* of the potential wilderness characteristics in order to merit protection.

During the scoping process, we provided GIS data regarding lands with wilderness characteristics, which not only constitutes significant new information but also facilitates the agency's review and consideration of protection. In *Oregon Natural Desert Association v. Rasmussen*, CV 05-1616-AS, Findings and Recommendations (D. Or. April 20, 2006); Order (D.Or. Dec. 12, 2006), the court found that BLM's failure to re-inventory lands for wilderness values and to consider the potential impact of decisions regarding management of a grazing allotment violated its obligations under NEPA and FLPMA, then enjoined any implementation of the decision until the agency re-inventoried the lands at issue and prepared an environmental document taking into account the impacts of its decisions on wilderness values. In *Oregon Natural Desert Association v. Rasumussen,* the district court found that BLM had violated NEPA by failing to consider significant new information on wilderness values and potential impacts on wilderness values, and had also failed to meet its obligations under FLPMA by failing to engage in a continuing inventory of wilderness values. It concluded:

> The court finds BLM did not meet its obligation under NEPA simply by reviewing and critiquing [a local environmental group's] work product. *It was obligated under NEPA to consider whether there were changes in or additions to the wilderness values* within the East-West Gulch, *and whether the proposed action in that area might negatively impact those wilderness values*, if they exist. The court finds BLM did not meet that obligation by relying on the one-time inventory review conducted in 1992. *Such reliance is not consistent with its statutory obligation to engage in a continuing inventory so as to be current on changing conditions and wilderness values*. 43 U.S.C. § 1711(a).
>
> BLM's issuance of the East-West Gulch Projects [environmental analysis] and the accompanying Finding of No Substantial Impact (FONSI) in the absence of current information on wilderness values was arbitrary and capricious, and, therefore, was in violation of NEPA and the [Administrative Procedure Act].

Id. (emphasis added).

The Geothermal PEIS presents an opportunity for the BLM to consider information that has previously been submitted regarding lands with wilderness characteristics in the lands at issue in the PEIS and to inventory these lands, which contain numerous areas proposed for wilderness designation in citizen's wilderness inventories and/or found to have wilderness characteristics. Prior to identifying lands open to geothermal leasing and development, we recommend that the agencies assess information received regarding wilderness characteristics, including inventorying lands identified, and exclude lands with wilderness characteristics, citizen-proposed wilderness, and wilderness inventory units from the lands available for consideration of siting geothermal energy projects.

c) Important habitat and migration corridors

The WGA has recently produced the Wildlife Corridors Initiative Report (available at http://www.westgov.org/wga/publicat/wildlife08.pdf), which identifies important wildlife corridors and habitats in the western states and makes recommendations for best protecting these crucial areas. The agencies should consult this report for information on the areas identified and/or confer with the WGA Western Wildlife Habitat Council before completing the PEIS, in order to incorporate this data into decisions regarding which lands will be available for leasing. The agencies should also ensure that additional analysis is conducted, in the PEIS and/or prior to leasing and development, to accurately determine the present of important habitat and migration corridors and to take appropriate measures to avoid or otherwise mitigate potential damage, as discussed in further detail in the following section of these comments. O-74-11

d) Places that would be excluded from development under bills pending in Congress

All areas that would be closed to geothermal development under bills currently pending in Congress should be excluded from leasing in the PEIS. This should include lands that are included in pending legislation for designation in one of the categories listed as closed to leasing in the Draft PEIS or would otherwise include provisions that prohibit geothermal energy development O-74-12

e) Recommended Areas for Exclusion in the San Luis Valley

As stated above, because siting of geothermal energy development will have significant and long lasting impacts on public lands, it is critical that the agency gather, analyze, and make available to the public any GIS layers that describe O-74-13 sensitive or protected areas. In addition to the lands with wilderness characteristics, citizen proposed wilderness, and wilderness inventories discussed above, we recommend that the agencies collect and use the following GIS data layers to map areas that are unacceptable for siting geothermal energy projects and in siting projects to avoid impacting the identified areas:

1. Baca, Alamosa and Monte Vista National Wildlife Refuges;
2. Great Sand Dunes National Park;
3. National Inventory Wetlands;
4. Riparian and significant (aquifer) recharge areas;
5. Colorado Division of Wildlife identified wetlands, wildlife habitat, corridors, wintering & calving grounds;
6. Colorado Natural Heritage Program wetlands, sensitive species habitat and Potential Conservation Areas (PCA's);
7. State designated Natural Areas;
8. Sites registered or eligible for registry under the National Historical Preservation Act (available from the Colorado Historical Society);
9. National Conservation Areas;
10. Other lands within BLM's National Landscape Conservation Systems such as Rio Grande Natural Area;
11. National Historic and National Scenic Trails;
12. Areas of Critical Environmental Concern (ACECs);
13. Citizen-proposed wilderness areas such as San Luis Hills/Flat Top Mesa pending legislation for designation in one of the above categories;
    a. Threatened, endangered and sensitive species habitat (available from USFWS[2], the Colorado Division of Wildlife and, for BLM lands, from NatureServe[3]; critical cores and linkages for wildlife habitat (available from USFWS and state wildlife agencies) and the Colorado Natural Heritage Program; and
    b. Riparian areas (available from SWReGAP[4], except for California, which is available from the UCSB Biogeography Lab[5]);
    c. Areas designated or under consideration for designation as "unique and irreplaceable" areas;
    d. Areas identified in the SLV Citizens Energy Initiative as unsuitable for geothermal development.

2. Designate minimum 10-mile buffer zones to protect geothermal resources already prioritized for recreational/scenic values.

a) Research shows that drilling for geothermal energy in proximity to other known geothermal features can disturb and damage these features.

The National Park Service's web page on Yellowstone's geothermal resources states, "In Iceland and New Zealand, geothermal drill holes and wells 2.5 - 6.2 miles distant have reduced geyser activity and hot spring discharge." (http://www.nps.gov/yell/naturescience/geothermalresources.htm) This confirms the necessity of creating buffer zones around geothermal resources with surface features that are part of protected areas, such as national parks, or have been identified for the recreational and scenic values. The SLV has a number of existing geothermal facilities including Valley View Hotsprings, Joyful Journey Hotsprings, Sand Dunes Swimming Pool & RV Park, and Colorado Alligator Farm. Siting additional geothermal installations near these facilities could have major negative economic and environmental impacts. Avoidance of Sand Dunes National Park, the Town of Crestone and adjacent Baca subdivision that houses the nations highest concentration of retreat centers should also be avoided. Tourism would decrease as a result of loss of thermal features, and endemic species that depend on the geothermal resources of the area would likely suffer. O-74-14

The New Zealand Geothermal Association provides evidence of damages caused to thermal features as a result of geothermal development that is not well-planned. Some environmental effects that have been documented include loss of active geysers, unsustainable draw down, and subsidence. According to the association, "Of more than 200 geysers in active in the central North Island in the 1950s, only about 40 remain."

[2] http://www.fws.gov/southwest/es/newmexico/ES_home.cfm
[3] NatureServe was contracted to identify and map locations of threatened and endangered species habitat that exist only on BLM lands – making these areas even more critical to the survival of the species. This data can be found at www.natureserve.org

[4] http://ftp.nr.usu.edu/swgap/
[5] http://www.biogeog.ucsb.edu/projects/gap/gap_home.html

(http://www.nzgeothermal.org.nz/environmental/surface_effects.asp) These potential impacts are unique to geothermal resources, and therefore must be analyzed thoroughly.

3. Identify and prioritize for leasing places that would be more appropriate for geothermal

In addition to avoiding ecologically and culturally sensitive lands, the PEIS can identify areas that are more likely to be suitable for development and non-controversial; and leasing could be prioritized in these areas. Factors that should be considered are set out below.

a) Impaired or degraded lands

The PEIS should require that lands that are already impaired be considered first for proposed geothermal development. Abandoned mines, developed oil and gas fields, and other brownfields, which are not being restored to ecological function, provide opportunities for geothermal energy development without loss of other uses and values. Such sites are often close to existing infrastructure, which is another important consideration, both in conjunction with degraded sites and as a separate factor. O-74-15

b) Proximity to existing infrastructure

The San Luis Valley has 31 existing electrical transmission substations. Prioritization of areas in proximity to these substations and other existing infrastructure will minimize new road construction or major roadway improvements (such as paving and widening), avoiding another set of impacts on the public lands. Further, proximity to the load that will be served by the project will limit the amount of new transmission needed and reduce related income. O-74-16

c) Areas identified in the SLV Citizens Energy Initiative

We invite and strongly encourage local USFW and BLM agency participation in the development of a SLV Citizens Energy Initiative. Agency/citizen collaboration will allow many issues and potential conflicts to be worked out early on in the planning process, thus resulting in better decision-making and a better outcome for all involved. O-74-17

d) Co-siting with solar energy projects

Federal land agencies are currently in the process of completing a PEIS for solar energy development as well. Both solar and geothermal energy are long-term, industrial uses of public lands. While we support the development of renewable, clean energy sources, we encourage the agencies to mitigate the impacts of all energy development to the extent possible. One mitigation measure that could prove greatly beneficial is the possibility of co-siting geothermal and solar energy projects, thereby reducing environmental impacts. The agencies should explore this possibility in the PEIS, and create terms to encourage this type of development. **Again, we caution that cumulative impacts of combined solar and geothermal proposals be carefully considered.** O-74-18

4. Consider phased leasing or conditional development leases

Because the current BLM geothermal program is very small in scale when compared to the reasonably foreseeable development scenario laid out in the Draft PEIS, the agencies should consider phased leasing until technologies are proven successful both in the utilization phase and in the reclamation phase.

We also reiterate our scoping comment that the PEIS should analyze the use of conditional-development lease stipulations. As it is often difficult at the time of leasing to have the best data on site-specific impacts for future geothermal full-field development within an area, a leasing stipulation that conditions the right of development on the results of future and more-detailed studies provides an opportunity to clarify that development may ultimately be limited. This type of stipulation could also be used to support a research and development program, as discussed below. O-74-19

5. Restrict development initially to traditional geothermal resources and/or established technology; commit to an R&D leasing program to develop additional technologies

a) Only technologies analyzed in this PEIS can be approved by tiering to the PEIS and important to use R&D leasing

O-74-20

It is essential that the PEIS clearly states that only geothermal technologies described and analyzed for impacts in the PEIS can be tiered to this document. These are specifically dry steam, flash steam, and binary-cycle power plants.

b) The agencies should support a program for developing new technologies, using R&D leasing

While we support research and development (R&D) of new geothermal technologies, especially those that reduce impacts on public lands by utilizing heat differential technology and thus do not require use of limited water sources, R&D activities require new NEPA analysis. Applications for R&D, including "enhanced geothermal systems," cannot be tiered to this PEIS because their impacts are not analyzed in the document. However, the PEIS could describe and commit the agencies to develop and support a R&D leasing program for new technologies, which could be facilitated through the use of conditional development leases. O-74-21

Recommendation: The management alternative to be selected for the PEIS should include the protective and proactive measures described above.

III. The PEIS Does Not Adequately Assess Environmental Consequences to Key Resources.

NEPA requires that the scope of environmental analysis be commensurate with the proposed action. *Kern v. United States Bureau of Land Management,* 284 F.3d 1062, 1072 (9th Cir. 2002). In light of the multistate range of lands and millions of acres that would be affected by the decisions in the PEIS, a more thorough analysis of potential impacts to other resources and values is necessary, as detailed below.

A. The agencies are required to assess the planning projects of other federal agencies and local governments in order to provide adequate cumulative impact analysis.

NEPA requires the agencies to consider the cumulative impacts of and related to the PEIS. NEPA regulations define "cumulative impact" as:

> "the impact on the environment which results from the *incremental impact of the action when added to other past, present, and reasonably foreseeable future actions* regardless of what agency (Federal or non-Federal) or person undertakes such other actions. *Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.*"

40 C.F.R. § 1508.7 (emphasis added).

To satisfy NEPA's hard look requirement, the cumulative impacts assessment must do two things. First, BLM must catalogue the past, present, and reasonably foreseeable projects in the area that might impact the environment. O-74-22 *Muckleshoot Indian Tribe v. U.S. Forest Service*, 177 F.3d 800, 809–10 (9th Cir. 1999). Second, BLM must analyze these impacts in light of the proposed action. *Id.* If BLM determines that certain actions are not relevant to the cumulative impacts analysis, it must "demonstrat[e] the scientific basis for this assertion." *Sierra Club v. Bosworth,* 199 F.Supp.2d 971, 983 (N.D. Ca. 2002). A failure to include a cumulative impact analysis of actions within a larger region will render NEPA analysis insufficient. *See, e.g., Kern v. U.S. Bureau of Land Management*, 284 F.3d 1062, 1078 (9th Cir. 2002) (analysis of root fungus on cedar timber sales was necessary for an entire area).

This definition clearly encompasses the other large-scale energy development being planned for the same lands under analysis in this PEIS, which will inevitably compound the effects of leasing and development of geothermal energy on the natural resources of our public lands, such as wildlife habitat, wilderness character and roadlessness, water, scenic beauty, and cultural resources.

Further, NEPA, as explained by the Council on Environmental Quality, also directs agencies to consider potential conflicts with the objectives of other plans, policies or controls, which requires an assessment of possibilities for resolving conflicts and a thorough consideration of how not resolving the conflict could "impair the effectiveness of land use control mechanisms for the area." 40 C.F.R. § 1502.16(c); *Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations*, 23a. Similarly, FLPMA requires that the BLM's guidance and management policies shall "be consistent with officially approved and adopted resource related policies and programs of other Federal agencies, State and local governments and Indian tribes." 43 U.S.C. § 1712(c)(9); 43 C.F.R.§1610.3-2.

There are currently several major planning processes underway in the Western United States that we want to highlight for the BLM to address in the Geothermal PEIS because of the potential overlap in goals. California's Renewable Energy Transmission Initiative (RETI), the Western Governors Association's (WGA) Western Renewable Energy

Zones (WREZ), and the West-wide Energy Corridors PEIS are all transmission initiatives in the project area. The states of Colorado, New Mexico, and Nevada also have initiatives to identify locations and provide incentives for renewable energy development and transmission.

The West-wide Energy Corridor PEIS is of particular relevance to the Geothermal PEIS. These two processes should be viewed as an opportunity for synergy and as an opportunity to bring more renewable energy into the American electricity grid while minimizing environmental degradation. If both energy corridors and geothermal energy development projects are properly sited and renewable technologies such as solar, wind, and geothermal energy are given preference in new transmission rights-of-way within the corridors, these efforts together can help America reduce its reliance on the fossil fuels responsible for global climate change. Currently, the West-wide Energy Corridor PEIS is the subject of significant controversy, due to the failure to assess the need for corridors to support renewable energy, as well as the failure to avoid ecologically important areas. Although the Draft PEIS makes note of this initiative, it fails to provide analysis of the cumulative impacts that will result from both of these programs being established in the same project area.

In addition, BLM is preparing a solar energy program and oil shale/tar sands program and has recently completed a wind energy program. All of these planning processes impact lands in the western states and will utilize transmission corridors, and in combination have the potential to disturb a majority of public and Forest Service lands in the West.

Chapter 5 of the Draft PEIS states that geothermal development would have a minor cumulative impact on resources such as vegetation and soil due to its comparatively small footprint: "The contribution to cumulative impacts of geothermal projects on public and FS lands would be small or negligible unless a significant permanent, uncompensated loss of the current productive use of a site occurred, or if future uses were precluded" Draft PEIS at 5-18. However, in context of a small area cleared for geothermal, and other areas all over the West cleared for solar, wind, oil shale, and transmission for all of these energy sources, the cumulative impacts can actually be expected to be quite large, with geothermal development making a significant contribution. In addition, because transmission will be necessary for indirect use geothermal projects, it is imperative that the agencies analyze transmission initiatives in the project area and provide cumulative impact analysis. Disregard of these processes may lead to duplicative corridors and unnecessary lands, wildlife and natural resource impacts.

Before preparing the Final PEIS, the agencies must go back and analyze not just the small impacts from geothermal plants, but the *cumulative* impacts of geothermal plants and transmission in context with solar plants, wind turbines, oil shale and tar sands mines, and the many other planning processes in the project area.

Recommendation: Because leasing of land for geothermal development is a commitment of the resource for future exploration and development, the agencies must conduct cumulative impact analysis of reasonably foreseeable future actions in context of other energy development and transmission projects in the western states.

B. Socioeconomic analysis.

There are several areas where the Draft PEIS for Geothermal Leasing in the Western US (Draft PEIS) falls short in the analysis of the potential socioeconomic impacts associated with leasing public lands for the development of geothermal energy. These are described briefly below and discussed in greater detail in the sections which follow.

1) The socioeconomic analysis in the Draft PEIS is rather superficial and is based heavily on documents which were produced by the geothermal energy industry itself.

2) The analysis of the socioeconomic impacts is one sided, focusing only on the potential benefits of geothermal energy development without assessing the potential costs of such development on public lands.

   a. The Draft PEIS fails to address the potential impacts to rural economies from potential impacts to public lands. Many economies benefit from undeveloped public lands and this potential impact should be analyzed in the Final EIS.

   b. The Draft PEIS does not account for the non-market values, including the impacts on local quality of life, which are associated with the undeveloped public lands that may be impacted by geothermal energy development.

These specific concerns are discussed in detail in the sections below.

1. **The socioeconomic analysis in the Draft PEIS is rather superficial and is based heavily on documents that were produced by the geothermal energy industry itself.**

The Draft PEIS presents only the most general estimates of the potential jobs and royalties (and these are based only on industry references), without any in-depth analysis or even a qualitative discussion of the overall potential socioeconomic impacts associated with large scale developments on public lands in rural areas.

The socioeconomic analysis in the Draft PEIS refers frequently to several documents that were produced by or for geothermal industry advocacy groups. One of these documents is a two-page promotional document touting only the potential beneficial economic impacts of the industry. They are clearly self-serving for this specific industry, and while potentially a valuable source of information, they should not be the only source of information about the socioeconomic impacts of large-scale geothermal energy development on public lands. O-74-23

In preparing the Final EIS we request that the BLM and FS do a review of the economic literature on modern rural economies and include analysis of a broader range of impacts. In particular, the emerging economy of the San Luis Valley relies increasingly upon visitors to the Crestone area that attracts tens of thousands of visitors every year to its many retreat centers. This somewhat unique "retreat economy" depends upon quietude, scenic views, a pristine environment and maintenance of a rural ambiance. Other important aspects of the SLV's emerging economy are recreation, and cultural and ecological tourism. The PEIS and management planning analysis must also include input and research on these important emerging "non-traditional" economies rather then relying solely on conventional industry analyses.

2. **The analysis of the socioeconomic impacts is one sided, focusing only on the potential benefits of geothermal energy development without assessing the potential costs of such development on public lands.**

While it is certainly possible that the benefits to local communities from geothermal energy development may be substantial, it is also quite likely that such development will have certain costs as well. The Draft PEIS does not analyze the potential costs associated with leasing millions of acres of BLM and FS lands for geothermal energy. The Draft PEIS merely assumes that mitigation, stipulations and BMPs will result in minimal impacts. O-74-24

Western communities often face the need to balance extractive development and other industrial uses of the region's abundant public lands with the economic and aesthetic benefits that are derived from these lands in their undeveloped state. The economy of the western United States has long been viewed as one dependent upon the extraction of natural resources. However, recent research has shown that this assumption is no longer valid. Commercial geothermal development would be yet another such industrial use, with many of the attendant pitfalls and issues. Yet the Geothermal DPIES does not assess the impacts associated with continued reliance on extraction industries in the context of the changing economy of the region.

a) **The Draft PEIS fails to address the potential impacts to rural economies which benefit from undeveloped public lands – lands which will be impacted by the development of geothermal energy projects and related transmission corridors.**

The omission of the potential costs to the western economies affected is reflected in the list (on page 4-139 of the Draft PEIS) detailing the conditions under which potential impacts on socioeconomics and environmental justice could occur. This list focuses very narrowly on commodity impacts, jobs and income in the geothermal industry, and revenues from royalties and taxes that might accrue. The list mentions the potential for increases in population and the potential for these increases to strain local resources; however, the analysis does not treat this potential impact with any depth. Missing from the list are the potential impacts on businesses and individuals who may rely on the presence of protected public lands to attract employees, to attract customers or for their own quality of life. O-74-25

In the last 30 years, the West has evolved beyond being a region whose economy was largely focused on extractive industries, into a more diverse economy (Bennett and McBeth, 1998; Johnson, 2001). As the economies of rural communities in the West evolve, the impact of public land management on these economies also evolves, and the management of our public lands must as well. Sociological and economic research conducted over the last two-plus decades indicates that the environmental amenities provided by public lands are an important economic driver in the rural West. For several examples see: Rudzitis and Johansen, 1989; Johnson and Rasker, 1993, 1995; Rasker 1994; Power, 1995, 1996; Duffy-Deno, 1998; Rudzitis, 1999; Rasker,et al. 2004; Holmes and Hecox, 2004; Whitelaw, et al. 2003.

These indicators include the growing importance of non-labor income from investments and retirement, increasing employment in high technology, knowledge-based, and service industries, the important role that recreation and tourism plays in providing jobs and income, and the rise of small businesses and other entrepreneurial endeavors. The Draft PEIS fails to analyze or account for negative impacts on these segments of the economy. Large-scale geothermal energy development is likely to have negative impacts such as habitat fragmentations, loss of quality of life, loss of quality recreation, and reduced quality of hunting and fishing. These impacts can, in turn, have detrimental consequences for non-traditional sectors of the economy that have come into prominence in the West. These non-traditional sectors have been shown to rely upon protected, undeveloped public lands. Such lands enhance the attractiveness of rural western communities for businesses, workers and retirees who are not tied to specific locations for income or employment. These sectors have for decades been the largest portion of almost every county in the U.S. This is particularly true for the San Luis Valley, Colorado.

The recreation opportunities alone provided by wilderness quality and other undeveloped public lands yield direct economic benefits to local communities. The Draft PEIS socio-economic analysis does not include an analysis of the income and jobs associated with recreation, hunting and fishing from each alternative. In our scooping comments, we included a document entitled "Socio-Economic Framework for Public Land Management Planning: Indicators for the West's Economy," which details our expectations for the baseline analysis of the region's economy as well as the analysis of the potential impacts of this program. We request that you re-review the document and that your analysis for the Final EIS follow the approach set out in this document.

b) The Draft PEIS does not account for the non-market values, including the impacts on local quality of life, which are associated with the undeveloped public lands that may be impacted by geothermal energy development.

Public lands provide numerous values, some of which are realized when natural resources are extracted, and others which require that the natural ecosystems remain intact. The benefits of these various values often flow to different groups or individuals. Some of the benefits from public lands are more likely to flow to individuals or companies (market benefits), and others are available for the entire population (non-market benefits).

Any time that unique or irreplaceable resources or values are at risk, there is a strong component of non-market value which must be assessed. One of the primary purposes of the public lands system is the provision of public goods such as the protection of unique landscapes, ecological diversity, wildlife habitat, wilderness, and cultural and archeological resources. Large-scale geothermal energy development may put these resources at risk. O-74-26

To facilitate informed decisions about publicly owned wildlands, economic analysis must take into consideration both market and nonmarket benefits and costs (Loomis 1993). It is important that the FS and BLM examine both market and non-market benefits and costs of large-scale geothermal energy development. Non-market benefits must be measured and compared with the market benefits that accrue to companies and individuals when undeveloped public lands are developed.

In analyzing the socioeconomic impacts of geothermal energy leasing and development, the agencies must complete a full accounting of the costs and benefits associated with this development including non-market costs and benefits. The agencies' accounting should recognize the multiple use aspects and the full extent and value of existing wilderness character and wildlands as a resource within and near new geothermal energy development, which include formally designated Wilderness and Wilderness Study Areas, as well as other areas with wilderness and special characteristics identified by citizens and proposed for protective management. The multiple benefits that derive from protecting wilderness quality and other undeveloped lands include positive economic impacts to local communities. In developing the Final EIS, the agencies should analyze the benefits of protecting all existing wilderness character and wildlands against impairment from large-scale geothermal energy development, and should also consider how managing these lands will affect wildlands and wildlife in other locations and in turn the economies in local communities.

Recommendations: In preparing the Final EIS for geothermal leasing, the BLM and FS must:

- consider the increasing importance of industries and economic sectors that rely on public lands for environmental amenities;
- examine the potential impacts that large-scale geothermal development on public lands may have on key indicators which characterize the modern western economy; and
- estimate the potential non-market benefits and costs associated with large-scale geothermal energy.

C. Visual resources

NEPA requires the agencies to "assure for all Americans . . . aesthetically . . . pleasing surroundings." 42 U.S.C. § 4331(b)(2). FLPMA specifically directs the BLM to prepare and maintain inventories of the visual values of all public lands, 43 U.S.C. § 1711(a), and manage public lands "in a manner that will protect the quality of . . . scenic . . . values," §1701(a)(8). BLM has interpreted these mandates as a "stewardship responsibility" to "protect visual values on public lands" by managing all BLM-administered lands "in a manner which will protect the quality of the scenic (visual) values." BLM Manual 8400 – Visual Resource Management .02, .06(A). BLM utilizes visual resource inventories during its land use planning process to establish management objectives, organized into four classes. These objectives are as binding as any other resource objectives contained in the RMP. *See Southern Utah Wilderness Alliance*, 144 IBLA 70, 84 (1998). O-74-27

These statutory and regulatory responsibilities are especially important because of the scenic values associated with use and enjoyment of the public lands and national forests, and also with the use and enjoyment of geothermal areas, specifically. The agencies should ensure that natural settings are protected – these settings are often vital to local and regional economies and for cultural resources. Viewsheds and scenic values should be considered as a factor for establishing buffers of protection from surface disturbance that are particularly important to local retreat-based economies of Crestone and other communities located at the Mountain/Valley intersect in the San Luis Valley.

D. Wildlife habitat and fragmentation analysis

1) Endemic species

Warm and hot water ecosystems are unique in the San Luis Valley. There are numerous species that rely on the geothermal characteristics of their habitat for survival. The PEIS should clearly identify these species, their range, potential impacts, and appropriate protections and mitigation measures and research needed to protect these unique organisms and ecosystems. O-74-28

2) Habitat fragmentation analysis

Significant portions of the land that will be considered for geothermal energy development in the PEIS contain core habitat areas and migration linkages between those core areas, all of which need to be preserved in order for the regional ecosystems to continue to function. The San Luis Valley is home to numerous elk, pronghorn, mule deer and bighorn sheep and other wildlife populations that must migrate to survive, reproduce and maintain genetically diverse (and thus healthy) populations.

Fragmentation of wildlife habitat and migration corridors affects the genetics, ecological composition, structure, and functions of populations and landscapes. Habitat fragmentation has been defined as the "creation of a complex mosaic of spatial and successional habitats from formerly contiguous habitat" (Lehmkuhl and Ruggiero 1991). **Although fragmentation can be difficult to measure, there are a variety of metrics that can be used to assess the degree of existing habitat fragmentation and the condition of the landscape, then applied to available data regarding distribution of wildlife and habitat, and ultimately used to make decisions regarding appropriate locations for geothermal energy projects. We recommend that the agencies complete such an analysis as part of the PEIS.**

Existing road density can be calculated by measuring the length of linear features in a given sub-area at regular intervals and then reported as miles of route per square mile (mi/mi^2). The degree of habitat fragmentation, the distribution of unroaded areas, or core areas, can also be measured and calculated based on the amount of land beyond a given distance or effect zone, from transportation routes (Forman, 1999). Wildlife species respond to disturbances related to this type of network at varying distances, so determining the size distribution of core areas for a range of effect zones (i.e., of 100ft, 250ft, 500ft and 1320ft) from all routes is also important. Wildlife literature will yield information on the effect zones for different species. For instance, an ongoing study by Sawyer et al. (2005, 2004, 2001) of GPS collared deer on the Pinedale Anticline observed that deer utilized habitat progressively further from roads and well pads over three years of increasing gas development and showed no evidence of acclimating to energy-related infrastructure. Birds are also impacted by roads and management practices associated with energy development, due to fragmentation, changes in vegetation and noise (Mabey and Paul, 2007; Robel, et al., 2004). O-74-29

In addition to geothermal projects themselves, habitat fragmentation can be caused by transmission corridors, which will be necessary to transmit geothermal energy to electricity grids. Wildlife habitat fragmentation caused by transmission lines, pipelines, and roads generally fall into three broad categories:

1. Construction impacts (access, right-of-way clearing, construction of towers, stringing of cables);
2. Line maintenance impacts (inspection and repair); and
3. Impacts related to the physical presence and operation of the transmission line.

As such, wildlife habitat must be examined on an individual project and site-specific basis. The only way to accomplish this requirement is to ensure that each individual geothermal project is spatially evaluated for direct, indirect and cumulative impacts.

Specific activities that negatively impact wildlife and cause destruction of core habitat or habitat fragmentation include the construction of facilities, disturbance of soil by the use of heavy machinery, site clearing and grading, noisy machinery during construction and maintenance, removal of vegetation, use of herbicides, well drilling, and accidental release of hazardous materials.

The effects of these activities on wildlife can be severe and include removal of habitat, fragmentation of habitat, and the creation of edge effect vegetation and habitat (changes in composition, structure, microclimate, etc. of area adjacent to facility and transmission corridor). Species shown to avoid edges include red-backed vole, snowshoe hair, pine marten and red squirrels. In addition, it is logical to suspect that construction of facilities and transmission in previously undisturbed areas will lead to a direct loss of life to wildlife during construction, operation and service of transmission lines.

We recommend that the BLM consult our organizations and utilize other resources including the Wilderness Society's most recent Science and Policy Brief, "Habitat Fragmentation from Roads: Travel Planning Methods to Safeguard BLM Lands". This report provides a summary of available scholarly and government reports and studies on the impact of habitat fragmentation on wildlife, provides methods for calculating habitat fragmentation, and provides recommendations on how to integrate fragmentation analysis into management. BLM should use the information provided in the SLV Citizens Energy Initiative, in this brief as well as related information from State Wildlife Action Plans, Audubon Important Bird Areas, and the Wildlands Network to identify core areas, measure habitat fragmentation, conduct a thorough fragmentation analysis, and inform decisions regarding designation of lands as available for geothermal energy in the PEIS, as well as incorporating these requirements into the PEIS to guide analysis of specific projects.

E. Wilderness and/or roadless and wetlands characteristics

As mentioned above, because the PEIS will be used to amend land use plans and tiered to in analyzing specific projects, the agencies must inventory the project area for lands with wilderness and/or roadless and wetlands characteristics and exclude these areas from leasing and development, in order to prevent destruction of these values. O-74-30

F. Cultural resources

The San Luis Valley is a treasure trove of cultural resources. Human history can be traced as far back as 11,500 years, to the early Clovis Hunters and the first *Homo sapiens* to enter the New World. Smithsonian Institute archeologists have long studied the Valley and recognized its invaluable contribution to our understanding of human history in North America. Native and prehistoric cultures also prize geothermal resources, such that there is a significant overlap between geothermal resources and sacred sites. The National Historic Preservation Act affords heightened protection to these resources, establishing a cooperative federal-state program for the protection of historic and cultural resources. In particular, the review process set out in Section 106 (16 U.S.C. § 470f) obligates the agencies to consider the effects of management actions on historic and cultural resources listed or eligible for inclusion under NHPA. Further, Section 110 of the NHPA requires the BLM to assume responsibility for the preservation of historic properties it owns or controls (16 U.S.C. § 470h-2(a)(1)), and to manage and maintain those resources in a way that gives "special consideration" to preserving their historic, archaeological, and cultural values. Section 110 also requires the BLM to ensure that all historic properties within the National Monument are identified, evaluated, and nominated to the National Register of Historic Places. *Id.* § 470h-2(a)(2)(A). O-74-31

The agencies must place special importance on consultation with archeological experts (including Smithsonian) and institutions such as the Colorado Historical Society (Office of Archaeology and Historic Preservation) and Native American Tribes and the PEIS should comment to a specific plan for ensuring identification, evaluation, nomination and protection of cultural resources prior to issuing leases.

G. GIS Data

As stated in our scoping comments, geographic information systems (GIS) data is critical for ensuring that existing resources can be mapped and considered in this PEIS and subsequent decisions. The agencies should not only obtain and analyze this data, they should also make it available to the public for use in understanding and commenting on impacts, as was done with the West-wide Energy Corridors Draft PEIS. O-74-32

1) Lands with wetlands and recharge characteristics: GIS layers needed to complete the PEIS.

Prior to identifying areas appropriate for geothermal energy development as part of the PEIS, it is imperative that the agencies gather the necessary information to ensure that wetlands are not disturbed. By collecting and using appropriate GIS data layers before considering appropriate places for geothermal leasing and development, the agencies can ensure that they avoid disturbing important areas and resources in the San Luis Valley. **We recommend that the agencies consider the SLV Citizens Energy Initiative recommendations and collect and use a wide variety of data layers to map areas that are unacceptable for siting geothermal projects and in siting projects to avoid impacting highly sensitive and resource rich areas.** O-74-33

We are not sure of the state of wetlands designations within the SLV beyond the National Wetlands Inventory. BLM should incorporate all available data on wetlands and recharge areas in the SLV to identify exclusion areas for geothermal leasing. Further, in identifying additional lands with wetlands and recharge characteristics, BLM should use GIS mapping to identify exclusion areas, and the agency should make these data layers available to the public as part of their PEIS.

2) Other GIS layers needed to complete the PEIS

As stated above, because the siting of geothermal projects will have significant and long lasting impacts on public lands, it is critical that the agency gather, analyze, and make available to the public any GIS layers that describe sensitive or protected areas. In addition to the lands with wilderness, wetland and recharge characteristics, citizen proposed wilderness, and wilderness inventories discussed above, we recommend that the agencies **collect and use the following GIS data layers to map areas that are unacceptable for siting geothermal projects and in siting projects to avoid impacting the identified areas:**

1. Designated Wilderness Areas;
2. Wilderness Study Areas;
3. National Inventory Wetlands;
4. Significant Recharge Areas; O-74-34
5. National Parks and Monuments;
6. National Wildlife Refuges;
7. National Conservation Areas;
8. Potential cultural resources sites;
9. Other lands within BLM's NLCS;
10. National Historic and National Scenic Trails;
11. National Wild, Scenic, and Recreational Rivers, study rivers and segments, and eligible rivers and segments;
12. ACECs;
13. Threatened, endangered and sensitive species habitat (available from USFWS[6], state wildlife agencies and, for BLM lands, from NatureServe[7]; critical cores and linkages for wildlife habitat (available from USFWS and state wildlife agencies, including in State Wildlife Action Plans, as well as the Wildlands Project and its affiliated regional organizations[8]) important bird areas (available from BLM and the National Audubon Society[9]); and

[6] http://www.fws.gov/southwest/es/newmexico/ES_home.cfm

[7] NatureServe was contracted to identify and map locations of threatened and endangered species habitat that exist only on BLM lands – making these areas even more critical to the survival of the species. This data can be found at www.natureserve.org

[8] http://www.twp.org/cms/page1158.cfm

[9] http://www.audubon.org/bird/IBA/

14. Riparian areas (available from SWReGAP[10], except for California, which is available from the UCSB Biogeography Lab[11]).

Recommendations: The agencies should complete the additional collection of data and analysis of impacts outlines above, then revise the PEIS to incorporate the results into the selected alternative.

IV. Additional Analysis Is Required Prior to Leasing and Development.

The agencies have stated that this PEIS will be used to "develop a comprehensive list of stipulations, best management practices, and procedures to serve as consistent guidance for future geothermal leasing and development on public and NFS lands" and to "amend the BLM Resource Management Plans (RMPs) to adopt the resource allocations and procedures." 73 Fed.Reg. 33803. These uses require that the PEIS include sufficient environmental analysis to justify decisions and also commit the agencies to further analysis prior to approval of leasing. O-74-35

A. Tiering to the PEIS must be limited and unequivocal commitments to site-specific NEPA analysis included in the PEIS and land use plan amendments.

The PEIS will identify lands that are available for leasing. In order to support amendment of BLM land use plans and for the Forest Service and the BLM to tier to the PEIS in connection with subsequent decision-making processes, the analysis conducted under NEPA must be sufficiently robust to support the determination that specific lands are suitable for development. NEPA requires the agencies to take a "hard look" at the potential environmental consequences of this proposed action, so that they must assess impacts and effects that include: "ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative." 40 C.F.R. § 1508.8. In the context of a programmatic EIS, "the overview or area-wide EIS would serve as a valuable and necessary analysis of the affected environment and the potential cumulative impacts of the reasonably foreseeable actions under that program or within that geographical area." Council on Environmental Quality, *Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations*, Question 24b, available at http://ceq.hss.doe.gov/nepa/regs/40/40p3.htm. For future projects, the agencies can tier to the environmental analysis in the PEIS, but this incorporation "would be followed by site-specific or project-specific EISs," which "would make each EIS of greater use and meaning to the public as the plan or program develops." *Id.*, Question 24c.

In addition, NEPA requires the consideration of a reasonable range of alternatives as part of evaluation of a proposed action. NEPA requires the agencies to "rigorously explore and objectively evaluate" a range of alternatives to proposed federal actions. *See* 40 C.F.R. §§ 1502.14(a), 1508.25(c). "An agency must look at every reasonable alternative, with the range dictated by the nature and scope of the proposed action." *Nw. Envtl. Defense Center v. Bonneville Power Admin.*, 117 F.3d 1520, 1538 (9th Cir. 1997). An agency violates NEPA by failing to "rigorously explore and objectively evaluate all reasonable alternatives" to the proposed action. *City of Tenakee Springs v. Clough*, 915 F.2d 1308, 1310 (9th Cir. 1990) (quoting 40 C.F.R. § 1502.14). This evaluation extends to considering more environmentally protective alternatives and mitigation measures. *See, e.g., Kootenai Tribe of Idaho v. Veneman*, 313 F.3d 1094,1122–23 (9th Cir. 2002) (and cases cited therein). In the context of analyzing specific leases, the range of alternatives should also include an alternative not to lease at all.

The PEIS acknowledges the need for additional environmental analysis, although it defers the level of review for individual permits to be determined at the BLM field office or FS unit and provides for that analysis to be either an EIS or a "tiered environmental assessment (EA)," depending on the extent to which "this PEIS anticipates issues and concerns associated with individual projects, including potential cumulative impacts." Draft PEIS, p. 2-22. This statement properly acknowledges the need for site-specific analysis, but is too general.

Recommendation: Based on the general level of analysis included in the Draft PEIS, the PEIS and the subsequent amendments to BLM land use plans should specifically and unequivocally require site-specific environmental review prior to approval of projects, including opportunities for public comment and addressing direct, indirect and cumulative impacts. Both of these documents should state that an EIS will be presumed to be required unless the Forest Service or BLM determines that all site-specific concerns have been addressed in this PEIS and the cumulative impact analysis has not substantively changed. There should also be a specific commitment to considering a range of alternatives, including an alternative not to issue a lease for geothermal development.

B. Additional limitations on tiering.

[10] http://ftp.nr.usu.edu/swgap/
[11] http://www.biogeog.ucsb.edu/projects/gap/gap_home.html

The Draft PEIS acknowledges that the RFD, which forms the basis for the cumulative impact analysis, is limited, stating:

> The RFD was based on a review of recent government and industry reports providing assessments of geothermal potential across the western US (Western Governors' Association 2006; DOE and BLM 2003; NREL 2006; BLM 2007a; Geothermal Energy Association 2007a) and the typical impacts associated with geothermal development (GeothermEx 2007). Few quantitative evaluations have been conducted at this scale, and those that exist are considered largely speculative due to the wide array of variables around future geothermal development. These variables include the speculative estimation of unexplored geothermal resources, the development of geothermal technologies that may allow for extraction of resources currently unusable, the unknown nature of future energy markets, and the unknown future of regulatory and political climates.

O-74-36

Draft PEIS, p. 2-33. Accordingly, where technologies not specifically addressed in the PEIS are proposed, their environmental consequences have not been thoroughly discussed, requiring a new assessment. Similarly, where leases are proposed in areas that were not identified in the PEIS, new analysis is required. Further, if new technologies, geographic areas or economic, regulatory or other conditions change, the cumulative impact analysis in the PEIS will no longer by accurate.

<u>Recommendations</u>: The PEIS should clearly state the limitations of the issues analyzed, the limitations on tiering to the PEIS for environmental analysis, and the need to update the cumulative impacts analysis if relevant factors change.

C. Best management practices must be mandated for incorporation in all permits and should not be subject to waiver, exception or modification.

The Draft PEIS sets out important protective terms and conditions that should be incorporated into permits. *See*, Draft PEIS, pp. 2-16 – 2-17. However, different portions of the Draft PEIS refer to these terms and conditions as those that "will" or "may" apply, giving the impression that some of these terms are required to be incorporated into permits and others may not be, even when they are applicable to a proposed location. Further, since the BLM routinely permits waiver, exception and modification of stipulations and conditions in the context of oil and gas development, there is not guarantee that these measures will be applied.

O-74-37

Best management practices are an important vehicle for mitigating impacts of geothermal development. However, without a definitive commitment to their use, these practices cannot be relied upon to reduce environmental consequences. *See, e.g.*, Council on Environmental Quality, *Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations*, Question 19, *Davis v. Mineta*, 302 F.3d 1104, 1125 (10th Cir. 2002).

<u>Recommendation</u>: The PEIS must clearly state that all best management practices, stipulations and conditions are required to be incorporated into permits where the resources that they are designed to protect are present. Further, these provisions should not be subject to waiver, exception or modification unless very narrow, specific qualifications are met and should not be available at all in the context of no surface occupancy stipulations.

D. Compliance with Section 106 of the NHPA and Section 7 of the ESA.

The San Luis Valley is a treasure trove of cultural and historical resources. Smithsonian Institute researchers have worked in the SLV for over 20 years. They and the Colorado Office of Archaeology and Historic Preservation should be Cooperating Agencies on any geothermal proposal in the SLV. The Draft PEIS states that consultation under Section 106 of the National Historic Preservation Act and Section 7 of the Endangered Species Act will occur prior to leasing and additional consultation will occur as needed for specific projects. Draft PEIS, p. 2-21. O-74-38

<u>Recommendation</u>: The PEIS should maintain a specific commitment to engaging in consultation prior to leasing and as needed throughout evaluation of a project.

V. <u>The Pending Applications Should Be Assessed in Accordance with the Recommendations Set Out for New Leasing.</u>

A. Pending lease applications should be subject to the screens listed in Section II prior to approval

O-74-39

The 19 pending lease applications should be subject to the screens listed in Section II. Any pending lease applications which conflict with the screens in Section II should either be required to alter their boundaries to avoid citizen-proposed wilderness, inventoried roadless areas, lands with wilderness characteristics and other lands with special values, or the leases should be denied.

Recommendation: If pending applications conflict with the screens in Section II, the agencies should either alter the lease boundaries to avoid the conflict or deny the application.

B. Because the pending lease applications anticipate the use of binary cycle systems, the agencies should consider phased or limited approval and use of conditional development leases until the technology is proven to be successful

O-74-40

As stated in the sections above, because the binary cycle technology proposed for development in the pending lease applications has not been thoroughly tested, the proposed development requires a careful, measured approach to minimize potential impacts.

Recommendation: The agencies should consider phased/limited approval and use of conditional development leases until technology is proven to be successful.

VI. Cumulative Effects Under the National Environmental Policy Act.

O-74-41

For the energy corridors, the geographic area of impact should include a comprehensive inventory of resources (including but not limited to significant recharge areas, wetlands, riparian areas, wildlife habitat, wintering and birthing grounds), within areas of proposed development and their habitat extending outside such areas. The agencies can and should take the overall impacts of the corridors on the affected landscapes into account when considering their potential environmental consequences. *See*, e.g., Newmont Mining Corp., 151 IBLA 190 (1999) (Where the Bureau of Land Management could take into account the overall degradation from existing and connected proposed operations, a cumulative analysis of all impacts was required); Kern v. United States Bureau of Land Management, supra. (BLM must perform cumulative impact analysis of reasonably foreseeable future timber sales on spread of root fungus before approving single proposed sale). A landscape level analysis is an important part of a programmatic EIS, even if site-specific analysis might be deferred until authorization of specific projects. For instance, the U.S. Court of Appeals for the Ninth Circuit has held that analyzing the overall environmental risks involved in transporting oil from off-shore leases was appropriate and necessary in a PEIS, although specific analysis of individual pipeline locations could be deferred. County of Suffolk v. Secretary of Interior, 562 F.2d 1368, 1376-1377 (2nd Cir. 1977) (It was "essential to consider and weigh the environmental aspects of transportation, as well as of exploration and production."). In order to fulfill the mandate of NEPA that the agencies make an informed assessment of the environmental consequences of its actions, the landscape level effects of an expanded large-scale corridor system must be assessed.

3. Cumulative impact analysis should include other pending programmatic efforts (including solar) and additional development to be supported by new corridors.

As noted above, NEPA requires the agencies to consider the cumulative impacts of proposed projects and corridors. The CEQ's NEPA regulations define "cumulative impact" as:

> "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

40 C.F.R. § 1508.7.

The analysis of impacts in the PEIS must address the cumulative impacts of both the development of utility-scale geothermal energy projects, solar energy projects and other foreseeable connected activities within the same general area. The San Luis Valley is a contained, interdependent bioregion. Activities occurring in an isolated location can affect the entire valley. This is true especially for water and air – related impacts. The SLV is suitable for both geothermal and solar energy development, therefore it is **imperative that cumulative impacts be assessed for the Reasonable Foreseeable Future long-term effects of both solar and geothermal alternative energy development as a whole on the San Luis Valley.** The resources that allow an ecosystem to function often share a common geography, such that changes in the water quantity and/or quality in an aquifer or river system or impacts to an air shed (which may be affected by activities such as oil and gas drilling), all contribute in common. Similarly, changes to these resources may affect the core habitat and linkages that are critical for survival of wildlife and vegetation in a region. Accordingly, where there are shared environmental resources that can act as indicators of the health of ecosystems, the agencies must analyze all of the direct and indirect impacts that affect them.

The Environmental Protection Agency provides the following guidance to its reviewers on assessing the range of other activities to be considered in cumulative impacts analysis:

1. the proximity of the projects to each other either geographically or temporally;
2. the probability of actions affecting the same environmental system, especially systems that are susceptible to development pressures (such as in an aquifer system);
3. the likelihood that the project will lead to a wide range of effects or lead to a number of associated projects;
4. whether the effects of other projects are similar to those of the project under review;
5. the likelihood that the project will occur -- final approval is the best indicator but long range planning of government agencies and private organizations and trends information should also be used; and
6. temporal aspects, such as the project being imminent. U.S. Environmental Protection Agency, 1999, *Consideration Of Cumulative Impacts In EPA Review of NEPA Documents.*

In this case, the BLM's obligation to analyze impacts must encompass not only the proposed and projected geothermal energy projects, but also the cumulative impacts of the projects, taken together with the impacts of existing, proposed, or reasonably foreseeable projects, (including proposals currently being considered) on the environment. Thus, the BLM must analyze the cumulative impacts not just of the geothermal development projects, but also of other projects that will impact resources in common with this proposed action. As discussed above, there are other initiatives to support development and transmission of renewable energy projects and it is critical that the BLM coordinate with these processes and consider the cumulative impacts, which presumably can be reduced by proactive coordination, as well.

In determining the appropriate scope of environmental analysis for an action, the Government must consider not only the single proposed action, but also three types of related actions:

(1) Connected actions - Actions which are closely related and:
(i) Automatically trigger other actions that may require environmental impact statements;
(ii) Cannot or will not proceed unless other actions are taken previously or simultaneously; or
(iii) Are interdependent parts of a larger action and depend on the larger action for their justification.

(2) Cumulative actions – Actions, which when viewed with other proposed actions, have cumulatively significant impacts.

(3) Similar actions – Actions, which when viewed with other reasonably foreseeable or proposed agency actions, have similarities that provide a basis for evaluating their environmental consequences together, such as common timing or geography. 40 C.F.R. § 1508.25. Under any of these classifications, the coordinated actions that the agencies are taking though this PEIS trigger a broader assessment of the cumulative impacts.

The increased level of geothermal energy development projects that will follow the completion of this PEIS are also connected to new transmission projects that are likely to trigger preparation of an EIS. Impacts from transmission projects include direct affects to lands, wildlife and natural resources from the construction, ongoing maintenance and monitoring of transmission infrastructures and rights-of-way (ROW). These impacts include direct impacts to soils and vegetation due to clearing ROW, as well as direct wildlife impacts in terms of avian collisions and electrocutions. Indirect impacts include wildlife displacement, increased raptor prey opportunities on vertical structures and habitat fragmentation impacts on a variety of wildlife species. Additional transmission/ROW impacts to consider include noise, EMF, visual and aesthetic concerns.

In addition, the clustering of geothermal and solar energy development projects with projects to develop more traditional forms of energy in order to access the new transmission corridors proposed in the West-wide Energy Corridor PEIS are likely to have a cumulatively significant effect on the resources in the area. And, since the energy corridors and new transmission will be tied, at least to some extent, on the location of developable energy sources, including geothermal, these projects are certainly similar in terms of geography. Both the various programs and the increased development projects will have a connected and cumulative effect on resources ranging from elk and pronghorn herds to bird of prey populations, sage grouse populations, air quality, water quality (and erosion and sedimentation), and overall potential for primitive recreation. Therefore, their combined impact should be taken into account as part of the analysis of cumulative impacts associated with this PEIS.

With the western U.S. already possessing over 100,000 linear miles of power lines, the Geothermal PEIS should analyze opportunities to maximize current grid assets to transport newly developed geothermal energy instead of new power lines in new ROW. In addition, the PEIS should analyze opportunities at the major population centers to reduce generation import (and therefore transmission) needs by maximizing efficiency, distributed generation resources and other demand-reducing efforts.

Partial List of Documents Used to Formulate these Comments:

Habitat Fragmentation from Roads: Travel Planning Methods to Safeguard BLM Lands, The Wilderness Society.

Have Desert Researchers Discovered a Hidden Loop in the Carbon Cycle?, Science, Vol. 320, pp. 1094-140 (June 13, 2008)

Bennett, K. and McBeth, M.K. 1998. Contemporary Western rural USA economic composition: potential implications for environmental policy and research. Environmental Management. 22(3): 371-381.

Duffy-Deno, K. T. 1998. The effect of federal wilderness on county growth in the intermountain western United States. Journal of Regional Science. 38(1): 109-136.

Holmes, F.P. and Hecox, W.E. 2004. Does wilderness impoverish rural regions? International Journal of Wilderness. 10(3): 34-39.

Johnson, T.G. 2001. The rural economy in a new century. International Regional Science Review. 24(1): 21-37.

Johnson, J. and R. Rasker. 1993. The role of amenities in business attraction and retention. Montana Policy Review, Vol. 3, No. 2.

Johnson, J.; Rasker, R. 1995. The role of economic and quality of life values in rural business location. Journal of Rural Studies, 11(4): 405-416.

Loomis, J. 1993. Integrated public lands management. Columbia University Press, New York

Massachusetts Institute of Technology 2006. The Future of Geothermal Energy: Impact of Enhanced Geothermal Systems (EGS) on the United States in the 21st Century.

Morton, P. 1999. The economic benefits of wilderness: theory and practice. University of Denver Law Review. Volume 76, No. 2 pp. 465-518.

Power, T. 1995. Economic well-being and environmental protection in the Pacific Northwest: a consensus report by Pacific Northwest economists. Missoula, MT: University of Montana.

Power, T. M. 1996. Lost landscapes and failed economies. Island Press, Covelo, CA.

Rasker, R. 1994. A new look at old vistas: the economic role of environmental quality in western public lands. University of Colorado Law Review. Volume 52, Issue 2 pp369-399.

Rasker, R., Alexander, B., van den Noort, J., Carter, R. 2004. Public Lands Conservation and Economic Well-Being. The Sonoran Institute, Tucson, AZ.

Rudzitis, G. 1999. Amenities increasingly draw people to the rural West. Rural Development Perspectives. 14(3): 9-13.

Rudzitis, G.; Johansen, H. E. 1989. Amenities, Migration, and Nonmetropolitan Regional Development. Report to Nat. Science Foundation, Dept. of Geography, Univ. of Idaho.

Whitelaw, E., et al. 2003. A letter from economists to President Bush and the governors of eleven western states regarding the economic importance of the west's natural environment. (100 total authors) Available at: http://www.econw.com/pdf/120303letter.pdf

O-74-1

DOE and others are actively funding research to better understand the viability of recovering the heat from hot fluids from oil and gas wells (e.g., Rocky Mountain Oilfield Testing Center near Casper, Wyoming and research symposia and research at Southern Methodist University). It has been a very slow process, taking almost five years for both to get off the ground. In addition, with the publication of The Future of Geothermal Energy: Impact of Enhanced Geothermal System (EGS) in the United States by MIT in 2006, followed two years later by both the Department of Energy's recent RFP regarding further R&D on EGS, and Google Foundation's 2008 announcement of its funding of further EGS research and development, EGS development studies are ongoing. While neither BLM nor FS are research agencies, they pay very close attention to these studies.

Site-specific analysis of leases and project applications will also be necessary to address the particular impacts of future leases and projects from various technologies.

The PEIS also provides for mitigation and monitoring of leases, stipulations, and permit conditions, as discussed on page 2-20 of the Draft PEIS.

O-74-2

Please see response to comments I-2-4 and I-2-6 for a discussion of flash steam technology.

The PEIS covers geothermal leasing. Issuance of a lease does not require the lease holder to specify what kind or size of plant would be developed on the lease site; therefore, discussion of alternate technologies is not appropriate in this analysis (see Section 1.11.1 *BLM and FS Decisions to be Made Following Subsequent NEPA Analysis* for further discussion of permitting). All development and utilization and reclamation activities would be subject to further site-specific permitting and environmental analysis.

O-74-3

Prior to leasing, the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states typically manage and have regulatory authority for water quality, water rights, and wildlife. Site-specific impacts on water resources, including groundwater, would be addressed as part of the environmental analysis for the permitting process. All development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis, including public involvement as appropriate. BLM and FS would work with interested and affected parties to identify and resolve user or resource conflicts. Appropriate site-specific mitigation would be developed as necessary.

As discussed in section 1.5.1, water rights are administered and adjudicated at the state level. Each prospective lessee-developer will be required to apply for and obtain an adjudicated state water right before actually attempting to recover geothermal resources (see section 1.5.1).

O-74-4

As noted in the comment and in the PEIS, there are similarities in the leasing process and how geothermal resources are explored, drilled, and developed. The BLM and FS have appropriately applied many of the lessons of oil and gas to the development of the proposed action, including proactive stipulations.

O-74-5

The PEIS has been modified to include additional climate change discussion for affected resources. Please see the water, soil, vegetation, fish and wildlife, and other resource sections in the Final PEIS.

O-74-6

In accordance with 40 CFR Section 1502.13, the purpose of and need for the proposed action is used to define a range of reasonable alternatives (purpose of and need for action is defined in Sections 1.2 and 1.3). The BLM is making an allocation decision here and adopting a list of stipulations, BMPs, and compliance procedures to be incorporated in the land use plans. The PEIS analyzes in detail the Proposed Action, a No Action alternative, and a Leasing Near Transmission lines alternative. The Final PEIS incorporates input from public comments on the Proposed Action. Another alternative considered but eliminated from detailed study included no leasing or development of geothermal resources on public or NFS lands (Section 2.4.1). As explained in Section 2.4.1, this alternative, which would have been the most protective (from a ground disturbance standpoint), was eliminated because it would violate the multiple use provisions of FLPMA and is inconsistent with the President's National Energy Policy, the Energy Policy Act of 2005, and Executive Order 13212 and would not have fulfilled the purpose and need for the proposed action.

The alternatives analyzed represent a range of acreages as potentially available for leasing. See CEQ's *Forty Most Asked Questions Concerning the CEQ's NEPA Regulations*, Question 1b ("When there are potentially a very large number of alternatives, only a reasonable number of examples, covering the full spectrum of alternatives, must be analyzed and compared in the EIS.") In particular, the Leasing Near Transmission Lines alternative was developed based on public scoping comments to represent a limited development alternative. Instead of inventing a variety of alternatives that would lie between the alternatives presented, the BLM and FS elected to include protective measures (i.e., stipulations, BMPs, and compliance procedures) in each of the action alternatives. Further, those planning areas whose plans include more protective measures may elect to keep those measures in place, instead of the stipulations, BMPs, and compliance procedures presented in the Final PEIS.

O-74-7

The commentor's concerns with Alternative B are noted.

See the above responses in this letter for details on level of analysis and protections provided in the PEIS.

O-74-8

The commentor's concerns with Alternative C are noted.

O-74-9

The existing case law regarding the roadless rule is inconsistent. On August 12, 2008, the Wyoming District Court found the 2001 Roadless Rule violated NEPA and the Wilderness Act (*State of Wyoming v. US Department of Agriculture,* 07-CV-17-B, Wyoming District Court, Cheyenne, Wyoming [2008]). The District Court ordered the 2001 Roadless rule "set aside" and "permanently enjoined." This order is subsequent to a 2006 California District Court ruling that set aside the 2005 State Petitions Rule and reinstated the 2001 Roadless Rule. See *California ex re. Lockyer v. US Department of Agriculture*, 459 F.Supp.2d 874 (N.D. Cal 2006). The United States Justice Department, on behalf of the Department of Agriculture, has filed motions with both the Wyoming and California courts seeking adjustments of those courts' conflicting judicial orders. Neither the Wyoming nor California District Court rulings bar the Department of Agriculture from promulgating other roadless area regulations. To address this inconsistency, the PEIS includes the following Department of Agriculture Roadless Area Stipulation, "If future legislation or regulation change the roadless area designation, the restriction would be revised along with any appropriate environmental review." An appropriate NEPA review would be required prior to any changes to the Roadless Area Stipulation.

O-74-10

Decisions regarding the management of areas with wilderness characteristics are made at the field office level as part of the local land use planning process and not in this PEIS. This allows wilderness characteristics to be evaluated at a finer scale than afforded at a programmatic level. The management and level of protection of the wilderness characteristics on non-WSA lands is discretionary and not bound by requirements of the Wilderness Act of 1964 or the WSA Interim Management Policy (IMP, H-8550-1; BLM 1995); thus, these areas have no official status that removes them from consideration for leasing. Nonetheless, the BLM must consider in its NEPA analyses possible impacts on wilderness characteristics, if present, and may manage the lands to protect and/or preserve some or all of those characteristics through the local land use planning process.

As noted in Chapter 2 of the Draft PEIS, before making any leasing decisions, the BLM will assess whether the existing NEPA is adequate (i.e., through completion of a DNA), or whether there is new information or new circumstances that warrant further analysis. For example, additional NEPA analysis may be required in light of new information, or from a potential change in management approach regarding resources identified for special management (e.g., travel management planning or areas under consideration by BLM for management for wilderness characteristics).

O-74-11

Thank you for your comment. The PEIS does provide BMPs and stipulations that protect important migration corridors. Language has been revised in Section 2.2.2 *Procedures Prior to Leasing* to state:

- The authorized officer of the BLM or FS would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states manage and typically have regulatory authority for water quality, water rights, and wildlife; and

- The authorized officer of the BLM or FS would review the lands for any other sensitive resources (e.g., paleontological, BLM sensitive status species, and FS species of local concern) and provide for the necessary stipulations to protect these resources and ensure compliance with the land use plan. Assessment of the resource would include consulting with agency experts, coordinating with other appropriate agencies, and site surveys, if warranted.

- Prior to any geothermal development, site-specific NEPA would be conducted and migration corridors and important wildlife habitats would be identified. Appropriate measures, including but not limited to those provided in the list of BMPs, would be applied to protect these areas.

O-74-12

The BLM and operators would work with agencies and local stakeholders to identify areas requiring protection and mitigate impacts to special designation areas. See Section 4.2.8 for discussion of areas closed to leasing by Congressional designation.

O-74-13

Before issuing any leases the BLM would conduct the necessary review to ensure that leasing would be compatible with the local land use plan and site-specific resources, such as those included in the list provided in this comment. See chapter 2 for an in-depth discussion of areas closed to leasing.

O-74-14

Given that impact on geothermal resources from adjacent development may vary based on site-specific conditions, no specific buffer zone has been established for Yellowstone under the proposed action.

The BLM and FS are committed to working with the NPS to avoid adverse impacts to thermal features within NPS units. The language in Section 1.5.4 *Environmental Review Requirements Prior to Leasing* has been revised to clarify further that the BLM is prohibited from geothermal leasing on NPS lands as well as on lands where the Secretary has determined that geothermal operations are reasonably likely to result in a "significant adverse effect on a significant thermal feature" in a unit of the NPS. In addition, a list of the 12 units of the NPS with significant thermal features that occur in the study areas is now included.

Prior to inclusion of any specific parcels in a lease sale, the BLM and FS would coordinate with the National Park Service to determine if there would be any impacts to thermal or hydrological features within NPS units in proximity to a proposed lease. Language has been added to Section 2.2.2 *Procedures Prior to Leasing* to reiterate this point.

In addition, should development be determined to be reasonably likely to have an "adverse effect" on a significant thermal feature, the BLM would include appropriate lease stipulations to protect the park unit.

If it is determined in advance of leasing that exploration, development, or utilization of the lease parcel would "reasonably likely result in a significant adverse effect on a significant thermal feature of a National Park System unit," then the lease would not be issued (30 USC Section 1026[c]). While preexisting leases and permits are beyond the scope of this PEIS, the statute also provides that, if it is determined that use of an existing lease or permit would be "reasonably likely to adversely affect" any significant thermal feature within a National Park System unit, then stipulations are included on leases and permits to protect the thermal features (30 USC Section 1026 [d]).

O-74-15

This PEIS allocates areas as being available or closed to geothermal leasing. Stipulations have also been identified that would be applied to protect sensitive resources. Before issuing any leases, the BLM would conduct the necessary review to ensure that leasing would be compatible with the local land use plan and would comply with all applicable Federal, state, and local laws and regulations. As noted in Section 2.2.2, there are a variety of stipulations and BMPs that could be applied to address sensitive issues and conditions.

O-74-16

Please see response to comment O-74-16, above.

O-74-17

Please see response to comment O-74-16 above.

O-74-18

Please see response to comment O-74-16 above.

O-74-19

Please see response to comment O-74-16 above.

O-74-20

The PEIS covers geothermal leasing. Issuance of a lease does not require the lease holder to specify what kind or size of plant would be developed on the lease site. This document does predict a general level of anticipated future geothermal development in BLM areas that have geothermal potential and does discuss some of the available technologies, but it is not intended to provide full analysis of all phases of development. All development and utilization, including impacts of the specific technology used at plants, would be subject to further site-specific permitting and environmental analysis.

O-74-21

See the above response.

O-74-22

Additional discussion has been added to the cumulative impact analysis, including discussion on various ongoing transmission line projects and reasonably foreseeable transmission efforts. As noted in Chapter 5, past, present, and reasonably foreseeable actions, including commercial uses of public and federal lands, are documented and analyzed.

O-74-23

Additional text has been added to the socioeconomics sections in Chapter 3 and Chapter 4 to address non-market values.

O-74-24

Additional text has been added to the socioeconomics sections in Chapter 3 and Chapter 4 to address non-market values.

O-74-25

Additional text has been added to the socioeconomics sections in Chapter 3 and Chapter 4 to address non-market values.

O-74-26

Additional text has been added to the socioeconomics sections in Chapter 3 and Chapter 4 to address non-market values.

O-74-27

The comment is noted. No surface use stipulations for important viewsheds and BMPs for the protection of visual resources (see Appendix B) would be applied, as appropriate to land use plan revisions.

O-74-28

The BLM is proposing to include a Sensitive Species Stipulation for leases in areas that have agency-designated sensitive species. The stipulation could be a NSO, CSU, or TL in order to meet resource objectives (Page 2-19 of the Draft PEIS). This approach provides the flexibility to respond to the dynamic national and regional planning and protection efforts for these species. During the permitting process for any subsequent drilling or development applications, the BLM would conduct the appropriate analysis on siting locations, as noted in the comment.

To provide further protection for threatened, endangered, and sensitive species, the BLM will impose an Endangered Species Act stipulation (see Section 2.2.2) on all geothermal leases.

O-74-29

Thank you for your comment. Unfortunately, this level of data analysis is beyond the scope of the PEIS. The analysis in Chapter 4 is commensurate with the scope of the proposed action for the PEIS.

O-74-30

Decisions regarding the management of areas with wilderness characteristics are made at the field office level as part of the local land use planning process and not in this PEIS. This allows wilderness characteristics to be evaluated at a finer scale than afforded at a programmatic level. The management and level of protection of the wilderness characteristics on non-WSA lands is discretionary and not bound by requirements of the Wilderness Act of 1964 or the WSA Interim Management Policy (IMP, H-8550-1; BLM 1995); thus, these areas have no official status that removes them from consideration for leasing. Nonetheless, the BLM must consider in its NEPA analyses possible impacts on wilderness characteristics, if present, and may manage the lands to protect and/or preserve some or all of those characteristics through the local land use planning process.

As noted in Chapter 2 of the Draft PEIS, before making any leasing decisions, the BLM will assess whether the existing NEPA documentation is adequate (i.e., through completion of a DNA), or whether there is new information or new circumstances that warrant further analysis. For example, additional NEPA analysis may be required in light of new information, or from a potential change in management approach regarding resources identified for special management (e.g., travel management planning or areas under consideration by BLM for management for wilderness characteristics).

Please see the response to comment O-74-9 regarding roadless area regulations.

O-74-31

As stated in PEIS Section 2.2.2 *Procedures Prior to Leasing*, the authorized officer for the BLM or FS will consult with Native American Tribal governments, Alaska Natives, and State Historic Preservation Officers. Through consultation, the agencies would identify tribal interests and traditional cultural resources or properties that may be affected by the federal leases and potential geothermal energy development and the presence of archaeological sites and historic properties per Section 106 of the National Historic Preservation Act.

The programmatic EIS does not change existing closures, avoidance or protective measures developed for cultural resources, or tribal concerns. It does not constrain local FS or BLM offices from determining new restrictions or closures in land use plans or through special designations. It does describe a process to ensure that these concerns are addressed through tribal consultation at each phase of leasing and development.

O-74-32

The PEIS was based on the best available GIS data available and appropriate for the analysis, including from data sets used in the West-wide Energy Corridors Draft PEIS. The scope of the GIS data is discussed in Section 1.9.3 *Scope of GIS Data and Graphics of the Draft PEIS*.

While the BLM used the GIS data for programmatic level analysis, it is not necessarily appropriate for site-specific analysis. Maps from the Final PEIS will be provided on the public project website.

O-74-33

Available GIS data for the criteria listed in the Proposed Action (Section 2.1.1 *Identify Lands for Leasing*) were used for analysis, data calculations, and graphics.

O-74-34

Figures and acre calculations were developed using GIS for the criteria outlined in the Proposed Action (Section 2.1.1 *Identify Lands for Leasing*). As noted in this section, it included many of the layers listed in the comment. Other layers, including habitat data, watersheds, and soils, were used in preparing the affected environment sections and for the impact analysis.

O-74-35

Prior to making leasing decisions, BLM will assess whether the existing NEPA documentation is adequate (i.e., through completion of a DNA), or whether there is new information or new circumstances that warrant further analysis. As stated in the above responses, all development, utilization, and reclamation activities would be subject to further site-specific permitting and environmental analysis. This document does predict a general level of anticipated future geothermal development in BLM areas that have geothermal potential, but it is not intended to provide full analysis of all phases of development. There are several subsequent stages of decision making necessary to approve geothermal resource development, each with its own environmental compliance requirements, including public involvement, as applicable. This document covers only the land use planning and lease issuance stages.

O-74-36

Because it is difficult or even impossible to foresee all future permutations of possible geothermal development, the BLM could not create an exhaustive list of the limitations on the future use of this PEIS. Rather, as stated in the Draft PEIS, prior to making leasing decisions the BLM would asses whether the existing NEPA documentation is adequate (through completion of a DNA) or whether there is new information or new circumstances that warrant further analysis (see Section 2.2.2 *Procedures Prior to Leasing*).

O-74-37

It is important to clarify that stipulations are applied to leases, while BMPs are optional actions that can be applied to subsequent development permits based on local site conditions. As noted in Chapter 2 of the Draft PEIS, the stipulations provided in the PEIS would serve as the minimal level of protection and would be adopted into local land use plans upon signing of the ROD. If existing land use plans offer more protective measures or have resource-specific commitments, those more protective measures would apply instead. Section 2.2.2, subsection *Lease Exceptions, Waivers, and Modifications* discusses the limited circumstances under which lease stipulations can be excepted, waived, or modified.

O-74-38

As stated in PEIS Section 2.2.2 *Procedures Prior to Leasing*, the authorized officer for the BLM or FS will consult with Native American Tribal governments, Alaska Natives, and State Historic Preservation Officers. Through consultation, the agencies would identify tribal interests and traditional cultural resources or properties that may be affected by the federal leases and potential geothermal energy development and the presence of archaeological sites and historic properties per Section 106 of the National Historic Preservation Act.

O-74-39

The comment for suggested revision of lease boundaries has been noted.

The authorized officer always retains the discretion to reject geothermal lease applications or lease parcels prior to issuance or sale, respectively.

Stipulations have also been identified that would be applied to protect sensitive resources. Before issuing any leases, the BLM would conduct the necessary review to ensure that leasing would be compatible with the local land use plan and would comply with all applicable Federal, state, and local laws and regulations. As noted in Section 2.2.2, there are a variety of stipulations and BMPs that could be applied to protect sensitive issues and conditions.

Please see response to comment O-74-9 above for discussion of roadless area regulations.

O-74-40

The PEIS covers geothermal leasing. Issuance of a lease does not require the lease holder to specify what kind or size of plant would be developed on the lease site; therefore, discussion of alternate technologies is not appropriate in this analysis (see Section 1.11.1 *BLM and FS Decisions to be Made Following Subsequent NEPA Analysis* for further discussion of permitting). All development and utilization and reclamation activities would be subject to further site-specific permitting and environmental analysis.

O-74-41

Additional discussion has been added to the cumulative impact analysis. As noted in chapter 5, past, present and reasonably foreseeable actions including commercial uses of public and federal lands are documented and analyzed.

Stipulations have also been identified that would be applied to protect sensitive resources. Before issuing any leases, the BLM would conduct the necessary review to ensure that leasing would be compatible with the local land use plan and would comply with all applicable Federal, state, and local laws and regulations. As noted in Section 2.2.2, there are a variety of stipulations and BMPs that could be applied to protect sensitive issues and conditions.

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O-74-41

Additional discussion has been added to the cumulative impact analysis. As noted in chapter 5, past, present and reasonably foreseeable actions including commercial uses of public and federal lands are documented and analyzed.