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Coso Operating Company
Hay Ranch Water Extraction and Delivery System

Environmental Assessment

In Reply Refer To:
CACA-046289
CA-650-2005-100

December 2008

Prepared for:

U.S. Department of the Interior
Bureau of Land Management
Ridgecrest Field Office
300 S. Richmond Road
Ridgecrest, CA 93555

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ENVIRONMENTAL ASSESSMENT COVER SHEET

Project Title: Hay Ranch Water Extraction and Delivery System

Project Type: Water Extraction and Delivery System

Project Proponent: Coso Operating Company LLC
2 Gill Station Road, Coso Junction
Little Lake, California 93542
Contact: Chris Ellis, Site Manager

Project Location: The Project (Proposed Action) would occur within the U.S. Geological Survey (USGS) 7.5-minute Series Coso Junction and Cactus Peak Topographic quadrangles, Section 25, 26, 35, and 36 of Township 21 South and Range 37 East; Section 31, 32, 33, and 34 of Township 21 South and Range 38 East; and Section 1, 2, and 3 of Township 22 South and Range 38 East. The Project site lies immediately east of U.S. Highway 395. The entire Project includes approximately 9 linear miles of pipeline and the associated electric power substation, pumping equipment, and holding tanks. Less than 1.00 mile (5.63 acres) of the Project is on private land largely in Rose Valley and 5.32 miles (32.24 acres) of the Project lies within Bureau of Land Management (BLM)-managed lands then extends 2.67 miles (16.18 acres) onto the China Lake Naval Air Weapons Station (CLNAWS). The entire Project, including pipeline, tanks, and substation will be located within approximately 55.00 acres of land.

EA Number: CA-650-2005-100

Case File No.: CACA-046289

Date: Revised December 2008

Summary: Environmental review of each phase of the development for the Coso geothermal projects has been extensive. The mitigation measures required under existing documents were implemented by the Coso Operator facility-wide. The incorporation of the Hay Ranch Water Extraction and Delivery System into the existing Coso geothermal projects will allow greater latitude in development of the geothermal resource while resulting in no additional significant impacts.

Prepared for: Bureau of Land Management
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300 South Richmond Road
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ACRONYMS AND ABBREVIATIONS

AAM	Annual arithmetic mean
ACHP	Advisory Council on Historic Preservation
amsl	above mean sea level
APCD	Air Pollution Control District
APE	Area of Potential Effects
AQMD	Air Quality Management District
AQMP	Air Quality Management Plan
BLM	Bureau of Land Management
CAA	Clean Air Act
CAAQS	California Ambient Air Quality Standards
CALTRANS	California Department of Transportation
CARB	California Air Resources Board
CDCA Plan	California Desert Conservation Area Plan
CDFG	California Department of Fish and Game
CDPA	California Desert Protection Act
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CLNAWS	China Lake Naval Air Weapons Station
CNPS	California Native Plant Society
CO	carbon monoxide
COC	Coso Operating Company
CWA	Clean Water Act
DWMA	Desert Wildlife Management Area
EA	Environmental Assessment
EIR	environmental impact report
EIS	environmental impact statement
EPA	environmental protection agency
ESA	Endangered Species Act
FLPMA	Federal Land Policy and Management Act
gpm	gallons per minute
GBUAPCD	Great Basin Unified Air Pollution Control District
HMMP	Hydrologic Monitoring and Mitigation Plan
KGRA	Known Geothermal Resource Area
kw	kilowatt
LADWP	Los Angeles Department of Water and Power
LLR	Little Lake Ranch
MEER	mechanical-electrical equipment room
MOU	Memorandum of Understanding
mph	miles per hour
MW	megawatt
NAAQS	National Ambient Air Quality Standards
NAWS	Naval Air Weapons Station
NEPA	National Environmental Policy Act

NHPA	National Historic Preservation Act
NO	nitric oxide
NO_2	nitrogen dioxide
NRHP	National Register of Historic Places
NWC	Naval Weapons Center
O_3	ozone
Pb	lead
PM_{10}	Respirable particulate matter (up to 10 microns in diameter)
$PM_{2.5}$	Fine particulate matter (2.5 microns or less in diameter)
ppm	Parts per million
ROG	Reactive organic gas
SCE	Southern California Edison
SHPO	State Historic Preservation Officer
SO_2	Sulfur dioxide
SRRA	safety roadside rest area
TDS	total dissolved solids
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VRM	Visual Resource Management

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1. INTRODUCTION

The National Environmental Policy Act (NEPA) requires that the Bureau of Land Management (BLM) consider and document environmental impacts prior to making certain decisions. A critical portion of this Project lies within Navy-withdrawn lands that are part of the China Lake Naval Weapons Station (CLNAWS); therefore, the Navy also has an independent review role and discretionary approval authority under the 1979 BLM/NAWS Memorandum of Understanding (MOU) and the 1980 MOU amendment (Appendix A).

The Coso Operating Company LLC (COC or Project Proponent) has submitted a plan of operations for the Hay Ranch Water Extraction and Delivery System Project, which includes the proposed construction of a groundwater extraction and pipeline delivery system from the Coso Hay Ranch to the water distribution station and injection system located at the Coso Geothermal Field (the Project or Proposed Action). BLM and the Navy must each review and decide whether or not to grant approval of this Project, and have cooperated in the preparation of this Environmental Assessment (EA) to provide sufficient evidence and analysis for each independently to determine whether to prepare an environmental impact statement (EIS) or a finding of no significant impact with respect to the Project under NEPA. This document analyzes the environmental impacts and mitigation of impacts associated with the Proposed Action. It also determines whether significant impacts would result if the Proposed Action or alternatives were implemented.

1.1 Purpose and Need for the Proposed Action

The need for the Proposed Action is for the BLM to respond to the right-of-way request for the construction of an approximately 9-mile pipeline in a 50-foot-wide easement. The purpose is to provide access to allow for this Project.

The pipeline is intended to convey water from the Coso Hay Ranch to the existing Coso Geothermal Project on land administered as part of the CLNAWS. The Proposed Action is needed to supply supplemental injection water to replace geothermal fluid that is evaporating from the geothermal project's cooling tower during the summer months. The loss of the geothermal fluid has resulted in the decline in the reservoir, creating a reduction of megawatt production from the geothermal power plants. The water transported by the proposed pipeline will replace the evaporated geothermal fluid, resulting in minimization of the decline of the reservoir. Geothermal resources are an alternative to fossil fuels for the generation of electrical power.

1.2 Conformance with Land Use Plans

1.2.1 Federal

California Desert Conservation Area Plan

This Proposed Action is subject to the California Desert Conservation Area Plan (CDCA Plan), approved in 1980 and last amended in 2006 by the West Mojave Plan, which applies to the West Mojave Desert. The desert encompasses 9.3 million acres in Kern, Los Angeles, Inyo and San Bernardino counties. The BLM administers 3.3 million acres of the West Mojave Plan area. The West Mojave Plan requires that any project within the plan area adhere to any of its applicable environmental guidelines. The proposed Project area is not within a Desert Wildlife Management Area (DWMA).

The CDCA Plan designates 16 major Energy Production and Utility Corridors (CDCA Plan 1993) as a guide to consolidate compatible rights-of-way, avoid sensitive resources wherever possible, complete the delivery-systems network, consider ongoing projects for which decisions have been made, and to consider corridor networks that take into account power needs and alternative fuel resources. The scope of the CDCA Plan allows the designation of corridors that address the following types of utility facilities: (1) New electrical transmission towers and cables of 161 kV or above; (2) All pipelines with diameters greater than 12 inches, coaxial cables for interstate communications; and (3) Major aqueducts or canals for inter-basin transfers. The plan calls for these corridors to be designed to provide a 2-mile standard for separation of existing facilities and to accommodate flexibility in the selection of alternative routes for a right-of-way.

Under the BLM's Multiple-Use Class M (Moderate Use) designation, "New distribution facilities may be allowed and shall be placed within existing rights-of-way where they are reasonably available." The Proposed Action is covered by the Multiple-Use Class M designation under the 1980 CDCA Plan, as amended. Impacts associated with the Proposed Action on the 32 acres (5.32 miles) of BLM-managed lands would be confined to an area classified for Multiple-Use Class M.

In 1984, the CDCA Plan was amended to establish a 1-mile-wide, 5-mile-long corridor to connect the Coso Known Geothermal Resource Area (KGRA) with Utility Corridor A, which runs north and south along the existing power lines on the east side and adjacent to U.S. Highway 395. A 115 kV transmission line and a buried telephone cable line right-of-way (CA-13510 and CA-18885) previously authorized to California Energy Company, and subsequently assigned to Coso Power Developers, Coso Finance Partners, and Coso Energy Developers, basically follow the same route as the Proposed Action.

The majority of the proposed 20-inch pipeline to be located on public land is within the amended corridor. The remaining portion, located in section 36, T. 21 S., R. 37 E., deviates north of the amended corridor but is within the 2-mile width of Corridor A. Therefore, the proposed water distribution pipeline is consistent with the CDCA Plan.

1.2.2 Local Land Use Planning Considerations

5.63 acres of the Proposed Action area is on private land included within the Coso Hay Ranch property owned by the Project Proponent. This private land is designated as "unrestricted" in the 2001 Inyo County General Plan Update approved by the Inyo County Board of Supervisors on December 11, 2001 (Land Use Diagrams 1 and 22 of the general plan update). This general plan update includes provisions "to ensure the protection of the County's water resources from over utilization, export, and degradation" as part of the Conservation/Open Space Element. Policy WR-3.2 addresses the management of groundwater withdrawals, described as follows:

Policy WR-3.2 Sustainable Groundwater Withdrawal

Inyo County shall manage groundwater resources within the county through ordinances, project approvals, and agreements to ensure an adequate, safe, and economically viable groundwater supply for existing and future development within the county, shall protect existing groundwater users, maintain and enhance the natural environment, protect the overall economy of the county, and shall protect groundwater and surface water quality and quantity (Conservation & OS Element - B. - Modified Policy 4).

The groundwater source for water associated with the Project is subject to regulation under the Inyo County Groundwater Ordinance. The Project Proponent has applied for the issuance of a conditional use permit pursuant to that ordinance, and as a condition of its issuance, the Inyo County Planning Commission, based on recommendations from the Inyo County Water Commission, shall "approve and incorporate, as appropriate, a monitoring, groundwater management and/or reporting program into each conditional use permit of such scope and extent as the commission finds to be necessary to ensure that the proposed water transfer will not unreasonably affect the overall economy or the environment of the county" (Inyo County Groundwater Ordinance Section 18.77.035).

The Inyo County Planning Commission is evaluating the Project under the California Environmental Quality Act (CEQA) in connection with its action on the Project Proponent's application for a conditional use permit for the Project under the Inyo County Groundwater Ordinance. This regulatory process will ensure that the Project is conducted in a manner consistent with the Inyo County General Plan.

1.3 Federal Statutes and Regulations

1.3.1 Federal Land Policy and Management Act

In 1976, Congress passed the Federal Land Policy and Management Act (FLPMA), Public Law 94-57, 43 U.S.C. §§ 1701–1785, to direct the management of the public lands of the United States. In Section 601 of FLPMA, Congress required the preparation of the CDCA Plan. It is the purpose of this plan to establish guidance for the management of the public lands of the California desert by the BLM in clear accordance with the intent of Congress and the people of the U.S., as expressed in the law.

Section 601 of FLPMA requires that BLM develop a plan to "provide for the immediate and future protection and administration of the public lands in the California desert within the framework of a program of multiple use and sustained yield, and the maintenance of environmental quality." Section 103 of FLPMA defines the terms "multiple use" and "sustained yield" as follows.

The term "multiple use" means the management of the public lands and their various resource values so that they are utilized in the combination that will best meet the present and future needs of the American people; making the most judicious use of the land for some or all of these resources or related services over areas large enough to produce sufficient latitude for periodic adjustments in use to conform to changing needs and conditions; the use of some land for less than all of the resources; a combination of balanced and diverse resource use that takes into account the long-term needs of future generations for renewable and nonrenewable resources, including but not limited to recreation, range, timber, minerals, watershed, wildlife and fish, and natural scenic, scientific, and historical values; and harmonious and coordinated management of the various resources without permanent impairment of the productivity of the land and the quality of the environment with consideration being given to the relative values of the resources and not necessarily to the combination of uses that will give the greatest economic return or the greatest unit output.

The term "sustained yield" means 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.

Remarkable resources exist within the Project area, including important mineral and energy resources. The CDCA Plan mapped areas that may have potential for energy resources, including geothermal. The Proposed Action is located within the Coso KGRA.

1.3.2 Water Quality Protection

The federal Water Pollution Prevention and Control Act, 33 U.S.C. §§ 1251–1387, delegates to states the authority to regulate certain activities that may affect waters of the United States. California implements its delegated authority under the Clean Water Act (CWA) through the State Water Resources Control Board and the Regional Water Quality Control Boards. The Lahontan Regional Water Quality Control Board administers the Project area.

1.3.3 Air Quality Protection

The federal Clean Air Act (CAA), 42 U.S.C. §§ 7401–7671q, delegates to states the authority to regulate certain activities that may affect air quality. California implements its delegated authority under the CAA through 35 air districts, including 21 Air Pollution Control Districts (APCDs) and 14 Air Quality Management Districts (AQMDs). The Project area is located in Inyo County within the Great Basin Valleys Air Basin, managed by the Great Basin Unified Air Pollution Control District (GBUAPCD).

1.3.4 Protection of Wildlife

There are several categories of wildlife protection at both federal and state levels, depending on the magnitude of threat to continued existence and the existing knowledge of population levels. Special-status species include species that are listed as threatened or endangered either by the U.S. Fish and Wildlife Service (USFWS) or by the California Department of Fish and Game (CDFG). Special-status species are native species that have been accorded special legal or management protection because of concern for their continued existence.

The USFWS administers the Federal Endangered Species Act (Federal ESA), 16 U.S.C. §§ 1531–1599. The Federal ESA provides a process for listing species as either threatened or endangered and methods of protecting listed species. The Federal ESA defines “endangered” as any plant or animal species that is in danger of extinction throughout all or through a significant portion of its range. A “threatened” species is a species that is likely to become endangered in the foreseeable future. A “proposed” species is one that has been officially proposed by USFWS for addition to the federal threatened and endangered species list.

Section 9 of the Federal ESA prohibits “take” of threatened or endangered species. The term “take” means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in such conduct. Under the regulations of the Federal ESA, the USFWS may authorize “take” when it is incidental to, but not the purpose of, an otherwise lawful act.

Pursuant to Section 7 of the Federal ESA, BLM has initiated consultation with USFWS regarding the potential effects of the Project on the desert tortoise and its habitat (Appendix B, BLM letter to USFWS). CDFG administers the California ESA, Cal. Fish and Game Code §§

2050–2863. The State of California considers an endangered species one whose prospects of survival and reproduction are in immediate jeopardy; a threatened species is one present in such small numbers throughout its range that it is likely to become an endangered species in the near future in the absence of special protection or management. A rare species is defined as one present in such small numbers throughout its range that it may become endangered if its present environment worsens. The term rare species applies to California native plants. State-listed threatened and endangered species are fully protected against take, as previously defined. Species of Special Concern is an informal designation used by CDFG for some declining wildlife species that are not state candidates. This designation does not provide legal protection, but signifies that these species are recognized as special status by CDFG.

In support of the approval by the California Energy Commission (CEC) of the Small Power Plant Exemption for the Coso Navy 2 Geothermal Project, in 1988, BLM, CLNAWS, and CDFG entered into a Stipulation for Mitigation of Impacts to the Mohave Ground Squirrel at the Coso KGRA, which includes an Approved Mohave Ground Squirrel Mitigation Plan (Appendix C). The Mitigation Plan required the establishment of a 43,448.5-acre Coso Grazing Exclosure Mitigation Program, which includes Mohave ground squirrel trapping within the exclosure and evaluations every 5 years for the life of the Project. CDFG recognizes that the 1988 Stipulation is "grandfathered in" under the provisions of Cal. Fish and Game Code Section 2081, and, therefore, that no additional incidental taking authorization or habitat compensation will be required with respect to the potential impacts on the Mohave ground squirrel resulting from the Hay Ranch Project on the federal lands covered by the 1988 Stipulation and Mitigation Plan. Coso has submitted an application for a 2081 Incidental Take Permit with respect to the Mohave ground squirrel in relation to the Project activities to be conducted on private land.

1.3.5 The California Desert Protection Act

The California Desert Protection Act (CDPA), Public Law 103–433, protects 6.37 million acres managed by the BLM.

Sections of the CDPA that are pertinent to the Proposed Action include the following:

<u>Section 803. Withdrawals</u>

(a) CHINA LAKE

(1) Subject to valid existing rights and except as otherwise provided in this title, the federal lands referred to in paragraph (2), and all other areas within the boundary of such lands as depicted on the map specified in such paragraph which may become subject to the operation of the public land laws, are hereby withdrawn from all forms of appropriation under the public land laws (including the mining laws and the mineral leasing laws). Such lands are reserved for use by the Secretary of the Navy for:

(A) Use as a research, development, test, and evaluation laboratory;

(B) Use as a range for air warfare weapons and weapon systems;

(C) Use as a high hazard training area for aerial gunnery, rocketry, electronic warfare and countermeasures, tactical maneuvering, and air support;

(D) Geothermal leasing and development and related power production activities; and

(E) Subject to the requirements of Section 804(f) of this title, other defense-related purposes consistent with the purposes specified in this paragraph.

(2) The lands referred to in paragraph (1) are the federal lands located within the boundaries of the China Lake Naval Air Weapons Station (CLNAWS); comprising approximately 1,100,000 acres in Inyo, Kern, and San Bernardino counties, California, as generally depicted on a map entitled, China Lake Naval Air Weapons Station Withdrawal—Proposed, dated January 1985.

Section 805. Management of Withdrawn Lands

(g) MANAGEMENT OF CHINA LAKE

(1) The Secretary of the Interior may assign the management responsibility for the lands withdrawn under Section 802(a) of this title to the Secretary of the Navy who shall manage such lands, and issue leases, easements, rights-of-way, and other authorizations, in accordance with this title and cooperative management arrangements between the Secretary and the Secretary of the Navy *provided* that nothing in this subsection shall affect geothermal leases issued by the Secretary of the Interior prior to the date of enactment of this title, or the responsibility of the Secretary to administer and manage such leases, consistent with the provisions of this section. In the case that the Secretary assigns such management responsibility to the Secretary of the Navy before the development of the management plan under subsection (c), the Secretary of the Navy (after consultation with the Secretary) shall develop such management plan.

(2) The Secretary shall be responsible for the issuance of any lease, easement, right-of-way, and other authorization with respect to any activity, which involves both the lands withdrawn under Section 802(a) of this title and any other lands. Any such authorization shall be issued only with the consent of the Secretary of the Navy and, to the extent that such activity involves lands withdrawn under Section 802(a), shall be subject to such conditions as the Secretary of the Navy may prescribe.

(3) The Secretary of the Navy shall prepare and submit to the Secretary an annual report on the status of the natural and cultural resources and values of the lands withdrawn under Section 802(a). The Secretary shall transmit such report to the Committee on Energy and Natural Resources of the United States Senate and the Committee on Natural Resources of the United States House of Representatives.

(4) The Secretary of the Navy shall be responsible for the management of wild horses and burros located on the lands withdrawn under Section 802(a) of this title and may utilize helicopters and motorized vehicles for such purposes. Such management shall be in accordance with laws applicable to such management on public lands and with an appropriate memorandum of understanding between the Secretary and the Secretary of the Navy.

(5) Neither this title nor any other provision of law shall be construed to prohibit the Secretary from issuing and administering any lease for the development and utilization of geothermal steam and associated geothermal resources on the lands withdrawn under Section 802(a) of this title pursuant to the Geothermal Steam Act of 1970 (30 U.S.C. 1001 et seq.) and other applicable law, but no such lease shall be issued without the concurrence of the Secretary of the Navy.

(6) This title shall not affect the geothermal exploration and development authority of the Secretary of the Navy under Section 2689 of title 10, United States Code, except that the Secretary of the Navy shall obtain the concurrence of the Secretary before taking action under that section with respect to the lands withdrawn under Section 802(a).

(7) Upon the expiration of the withdrawal or relinquishment of China Lake, Navy contracts for the development of geothermal resources at China Lake then in effect (as amended or renewed by the Navy after the date of enactment of this title) shall remain in effect *provided* that the Secretary, with the consent of the Secretary of the Navy, may offer to substitute a standard geothermal lease for any such contract.

In general, the BLM is the lead agency and the CLNAWS is a cooperating agency on this Project. The 1980 amended MOU between the CLNAWS and the BLM will be in place to ensure that the CLNAWS' requirements on safety, security, and mission are recognized and constraints are understood. On the 2.67 miles (16.18 acres) of Navy-withdrawn lands outlined in this EA, the CLNAWS retains surface management and the BLM retains subsurface management. On BLM-managed lands, the BLM maintains both subsurface and surface management.

1.3.6 Plant Protection

As noted previously in Section 1.3.4, the Federal ESA provides a process for listing species as either threatened or endangered, and methods of protecting listed species. The Federal ESA defines "endangered" as any plant or animal species that is in danger of extinction throughout all or a significant portion of its range. A "threatened" species is a species that is likely to become endangered in the foreseeable future. A "proposed" species is one that has been officially proposed by the USFWS for addition to the federal threatened and endangered species list.

The California Native Plant Society (CNPS) has developed an inventory of California's special-status plant species (Skinner and Pavlik 1994). This inventory summarizes information on the distribution, rarity, and endangerment of California's vascular plants. The inventory is divided into four lists based on the rarity of the species. In addition, the CNPS provides an inventory of plant communities that are considered special status by the state and federal resource agencies, academic institutions, and various conservation groups. Determination of the level of a plant's sensitivity is based on the number and size of remaining occurrences as well as recognized threats.

Sensitive habitats are natural communities that support concentrations of special-status plant or wildlife species, are of relatively limited distribution, or are of particular value to wildlife.

It is BLM's policy to carry out management, consistent with the principals of multiple use, for the conservation of special-status plant species and their habitats and will ensure that actions authorized, funded, or carried out do not contribute to the need to federally list any of the species as threatened or endangered.

1.3.7 Protection of Cultural Resources

Several laws require consideration of cultural resources and Native American concerns. The National Historic Preservation Act (NHPA) Public Law 69–665, as amended, requires that federal agencies consider the effects of all actions on certain cultural resources and that those adverse effects to protected cultural resources be mitigated. It also requires that federal agencies consult with the relevant State Historic Preservation Officer (SHPO) and consider the views of Native Americans who may be affected. The NHPA also includes provisions for consulting with Native Americans on the effects of the Proposed Action to archaeological sites or areas of traditional use or concern. The American Indian Religious Freedom Act states that it is the policy of the United States "to protect and preserve for American Indians their inherent right of freedom to believe, express, and exercise the traditional religions of the American Indian, including but not limited to, access to sites." The Religious Freedom Restoration Act requires that federal agencies ensure that their decisions do not substantially burden the free exercise of religion by Native Americans. FLPMA and NEPA also have provisions for providing tribal officials with the opportunity to comment on planning and on NEPA documents. In connection with its evaluation of the Proposed Action, BLM has entered into a Programmatic Agreement (included as Appendix D of this EA) with the SHPO and the Advisory Council on Historic Preservation (ACHP).

1.4 Related Activities and Prior Environmental Review

Environmental aspects of geothermal exploration and development at the Coso geothermal project sites have been addressed in numerous documents. Beginning in 1979 and 1980, the Navy and BLM, respectively, issued EISs for the Navy-contract lands and BLM leases, evaluating development of the contract and lease lands. These initial EISs incorporated baseline technical reports for air quality, geology, hydrology, soils, field ecology, noise, and cultural resources. These documents also set the criteria under which future development would be considered.

Since 1980, various Plans of Operations have been filed with the Navy and BLM, as required under the Geothermal Resources Operational Orders, to address each stage of development on the Coso projects. Each of these plans was subject to environmental review under NEPA and CEQA. Listed in Table 1.4-1 are major NEPA and CEQA documents that have been prepared and approved for projects within the Coso KGRA.

The possibility of the use of groundwater from Rose Valley for power plant cooling was considered in prior environmental documentation (NWC 1979; BLM 1980a). The analyses in these earlier reviews, however, did not set forth a specific development and pipeline transportation proposal. The evaluations documented herein are tiered from those earlier environmental documents and their associated approvals. This includes the prior development and operation of the Coso Geothermal Development and the development of other projects in the area.

Table 1.4-1 Major NEPA and CEQA Documents within Coso KGRA

ISSUED BY	DOCUMENT
Naval Weapons Center (NWC) 1979	Final Environmental Impact Statement for the Navy Coso Geothermal Development Program, China Lake, California, Volumes 1 and 2
BLM 1980	Proposed Leasing within the Coso Known Geothermal Resource Area (KGRA): Final Environmental Impact Statement
NWC 1981	Environmental Impact Statement for Navy Coso Geothermal Development Program, Volume 3, Supplemental EIS for Exploratory Drilling and Testing (Tier 3)
NWC 1983	Environmental Assessment for Proposed Exploration and Development within the Coso KGRA
NWC 1984	Preliminary Environmental Assessment for Additional Surface Disturbance for Construction of the 25 MWe Geothermal Power Plant Site and Definition of Pipeline Corridors
BLM 1984	Environmental Assessment for the LADWP Coso KGRA Exploratory Drilling Project
NWC 1985	Environmental Assessment of the Proposed China Lake Joint Venture well 63-18, Coso KGRA, Inyo County, California

Table 1.4-1 Major NEPA and CEQA Documents within Coso KGRA	
ISSUED BY	DOCUMENT
BLM 1985	Environmental Assessment of the Proposed Plan of Exploration, Federal Lease CA-11402, Coso KGRA, Inyo County, California
NWC 1986a	Environmental Impact Statement for Navy Coso Geothermal Development, Tier 4, Field Development
NWC 1986b	Environmental Assessment of the Proposed China Lake Joint Venture (CLJV) 28.5 Mile Devil's Kitchen to Inyokern High Voltage Transmission Line
NWC 1987a	Environmental Assessment of the Proposed CLJV Nine Well Pad Exploratory Drilling Program on Navy 2 Lands
NWC 1987b	Preliminary Environmental Assessment for Production Well Pads on Navy 1 Contract Lands, Coso KGRA
NWC 1987c	Preliminary Environmental Assessment of Four Production Wells and One Exploratory Core Hole on Navy/CLJV Contract Lands, Coso KGRA
NWC 1988a	Environmental Assessment/Initial Study of the CLJV Proposed Plan of Development on Navy Contract Lands
NWC 1988b	Environmental Assessment/Initial Study of the Proposed CLJV Navy 2 Geothermal Development and Utilization
BLM 1988	Environmental Assessment/Environmental Impact Report for the CalEnergy Plans of Utilization, Development and Disposal For Geothermal Development on BLM Geothermal Lease CA-11402
BLM 1989	Categorical Exclusion for Plan of Development for Federal Lease CA-11401
GBUAPCD 1995	Initial Study of Revision to Rule 424, Geothermal Emissions Standard
GBUAPCD/BLM 1999	GBUAPCD Initial Study and Negative Declaration and BLM finding of Categorical Exclusion for Plan of Operations for Federal Lease 11402 amendment which allows federal leases, CA-11383, 11384, and 11385 to be incorporated into the existing POO and subject to mitigation requirements of the 1988 EA/EIR for POU, development and disposal

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2. PROPOSED ACTION AND ALTERNATIVES

2.1 Proposed Action

The Project site encompasses an approximately 9-mile-long corridor with a 50-foot right-of-way. The Project site encompasses approximately 55 acres, which includes 5.63 acres of private land included within the Coso Hay Ranch, 32.24 acres on public lands managed by BLM, and 16.18 acres within the CLNAWS.

Private: Sections 25, 26, T. 21 S., R. 37 E., MDM, affecting 5.63 acres.

BLM: Sections 35 and 36, T. 21 S., R. 37 E., and Sections 31 through 34, and T. 21 S., R. 38 E., MDM, affecting 32.24 acres.

CLNAWS: Sections 1 through 3, T. 22 S., R. 38 E., MDM, affecting 16.18 acres.

The two existing wells, North Well and South Well, at the Coso Hay Ranch will be the source of the supplemental water. Groundwater is proposed to be pumped at a maximum rate of 4,000 gallons per minute (gpm) and at an average rate of 3,000 gpm (4,800 acre-feet per year). Pumping will be limited to off-peak periods to minimize the electrical power costs of operations.

A 12-inch pipeline is proposed for installation from the North Well past the South Well to a pump station located adjacent to the existing South Well, and would be located entirely on the Hay Ranch. At the pump station, a 250,000-gallon collection tank surrounded by a perimeter chain link fence would be constructed. From this collection tank, a 20-inch pipeline is proposed for construction along an existing access road, generally rising in elevation to Gill Station Road. The proposed pipeline alignment would cross Gill Station Road and proceed east adjacent to the road along the southern and western edges, approximately 50 feet from the edge of the road, until just east of the CLNAWS boundary gate. The 20-inch pipeline would then cross Gill Station Road just south of the CLNAWS gate and proceed easterly for approximately 1 mile on the eastern edge of the road. The pipeline would then cross back over the road to a 1.5-million gallon holding tank located at the high point within CLNAWS. The pipeline will mostly be buried, except for where volcanic outcrops would make it difficult; at those locations the pipeline would be constructed above the ground with pipe supports where needed (see Figure 1, Pipeline and Related Infrastructure). Water from the holding tank would be piped to the existing Coso Geothermal Project to the east with a 20-inch pipe proceeding underground approximately 50 feet from the road southeasterly to the injection system.

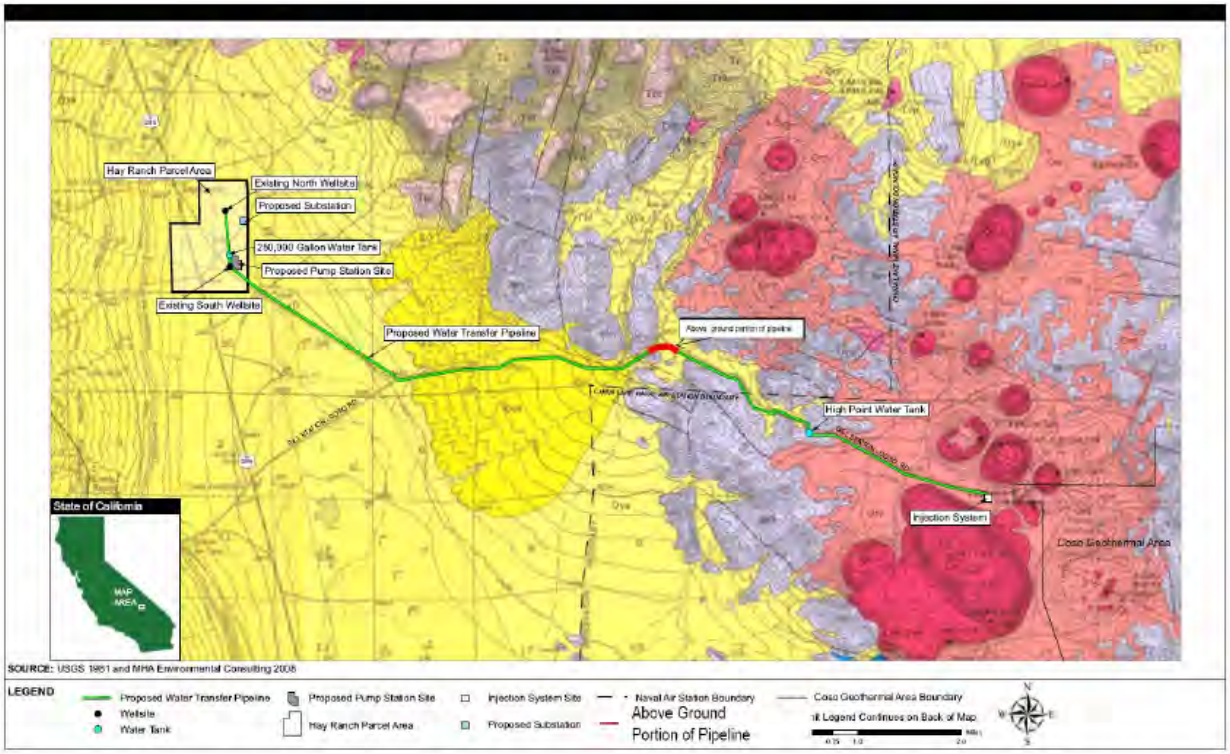

Figure 1. Pipeline and Related Infrastructure

The total power requirement for the downhole pumps, booster pump station, area lighting, and instrumentation is expected to be up to 2.5 megawatts (MWs). Power requirements will be at 4,160 volts (V) for the booster pump station, 480 V for the downhole pumps, and 120 V/240 V for area lighting and minor house loads. As a result, there will be at least four transformers required for the electrical installation, depending on the supply voltage from the local utility.

Power for the Project is proposed to be supplied by a new substation to be constructed by Southern California Edison (SCE) at a location immediately adjacent to the proposed location of the Project pumping equipment. The new substation will be tied into SCE's main transmission line, which runs past the Hay Ranch, using overhead transmission cables run on pole structures. The substation capacity will be approximately 3 MW to serve the Proposed Action load and an existing SCE customer load of less than 1 MW that SCE currently serves from the Los Angeles Department of Water and Power (LADWP) Haley substation.

The SCE substation is planned to be an unmanned, 115-12 kV, 28 MVA, SAS Automated Station constructed on a plot approximately 180 by 208 feet located within the Hay Ranch property. The substation site will contain a 115 kV low-profile switchrack with four bays; two 14 MVA transformers with isolating disconnects; surge arresters and neutral CTs; a 12 kV low-profile switchrack consisting of three positions, with provision to expand to four additional positions; and a prefabricated metal building.

It is anticipated that the substation may not be constructed in time for the initial pumping schedule. Two generators may be used for up to 12 months to power the electrical pumps prior to completion of the substation. These 1,500-kilowatt (KW) diesel powered generators will be used up to 18 hours per day, seven days per week.

Mechanical-Electrical Equipment Room

A prefabricated 16-foot by 10-foot mechanical-electrical equipment room (MEER) will be constructed and equipped with air conditioning and all standard equipment. It will contain control and relay panels, battery and battery chargers, AC and DC power distribution panels, HMI cabinet, communication equipment, telephone and fiber-optic communication, and local alarms.

Surfacing

The substation will be surfaced with three-quarter inch crusher-run untreated rock, 4 inches thick, and will be at the same level as the surrounding area.

Yard Lighting

The proposed substation will have both security and maintenance lighting. The security lights will be low-intensity lights integrated into the landscape and architectural aspects of the station. The security lights will be photo sensor controlled. Normal security light operation will be from dusk until dawn.

Maintenance lighting will consist of high-pressure sodium lights located in the switchracks, around the transformer banks, and in areas of the yard where maintenance activities may have to take place during nighttime hours. Maintenance lights will be controlled by a manual switch and will normally be turned off.

Grounding

All equipment and structures will be grounded per current SCE standards. Ground grid calculations will be based on soil resistivity measurements.

Landscaping

Landscaping around the proposed substation will be designed to filter views from residential and commercial areas. The landscaping plan will be prepared by a certified landscape architect. The landscape plan will include an 8-foot-high, chain link fence surrounding the proposed substation with security barbed wire mounted on the substation side of the fence. The existing metal storage building and mobile home will be removed from the properties.

2.2 Alternatives to the Proposed Action

Alternatives considered to accomplish the purpose of the Proposed Action for this Project were identified and considered by the BLM. In accordance with Title 40 CFR 1502.14 (a), reasonable alternative methods are limited by physical and land use/environmental factors. Physical factors include the geothermal well sites, the water pipeline and tanks, and access roads to the well field. Land use/environmental factors are those that limit such activities in undisturbed areas because of either specific land use designations and restrictions (e.g., multiple-use class designation, critical habitat/wilderness), or additional new negative significant environmental impacts that could occur when compared to using existing disturbed corridors/routes. Also considered was whether the alternative meets the purpose, need, and objectives of the Proposed Action; whether the alternative conflicts with a specific provision of the land use plan (CDCA Plan, including the Western Mojave Plan); whether the alternative directly conflicts with federal, state, and local laws and regulations; and whether the alternatives are technically and economically feasible.

2.2.1 No Action Alternative

The BLM would not issue a right-of-way for construction of a pipeline. Implementation of the No Action Alternative would result in no pipeline being constructed within land administered by the BLM or the CLNAWS. On a practical basis, the No Action Alternative would preclude the development and transport of supplemental water to the Coso Geothermal Project because there would be no alignment that would not pass through lands administered by the BLM and the CLNAWS. Implementation of the No Action Alternative would eliminate all of the impacts associated with construction of the pipeline. Additionally, implementation of the No Action Alternative would eliminate any direct or indirect impacts associated with groundwater pumping.

The No Action Alternative is included even though it does not meet the Project need because it is required by NEPA for consideration.

2.2.2 Other Alternatives Considered but Eliminated from Detailed Analysis

The Draft Environmental Impact Report (Draft EIR) for the Project (MHA 2008) identifies and analyzes a reasonable range of alternatives:

- Increasing power generation output through power plant enhancements;
- Alternative sources of injection waters, including groundwater wells on CLNAWS, groundwater wells in the Coso Basin, and marginal geothermal wells in the Coso Range;
- Reducing the duration of the proposed pumping;
- Pumping Hay Ranch wells at maximum rate sustainable for the 30-year project life without reaching trigger levels; and
- Pumping Hay Ranch wells at lower rates.

The BLM independently considered the analysis of these alternatives presented in the Draft EIR and incorporates that analysis by reference into this Environmental Assessment (EA) (Appendix E). Ultimately, the BLM has concluded that none of these alternatives is preferable to the proposed Project, considering the purpose and objectives of the Project and the comparative potential environmental effects of the Project and its alternatives. The reader is encouraged to refer to the alternatives analysis in Section 5 of the Draft EIR (presented in Appendix E of this EA for reference) for more detailed analysis of the alternatives considered.

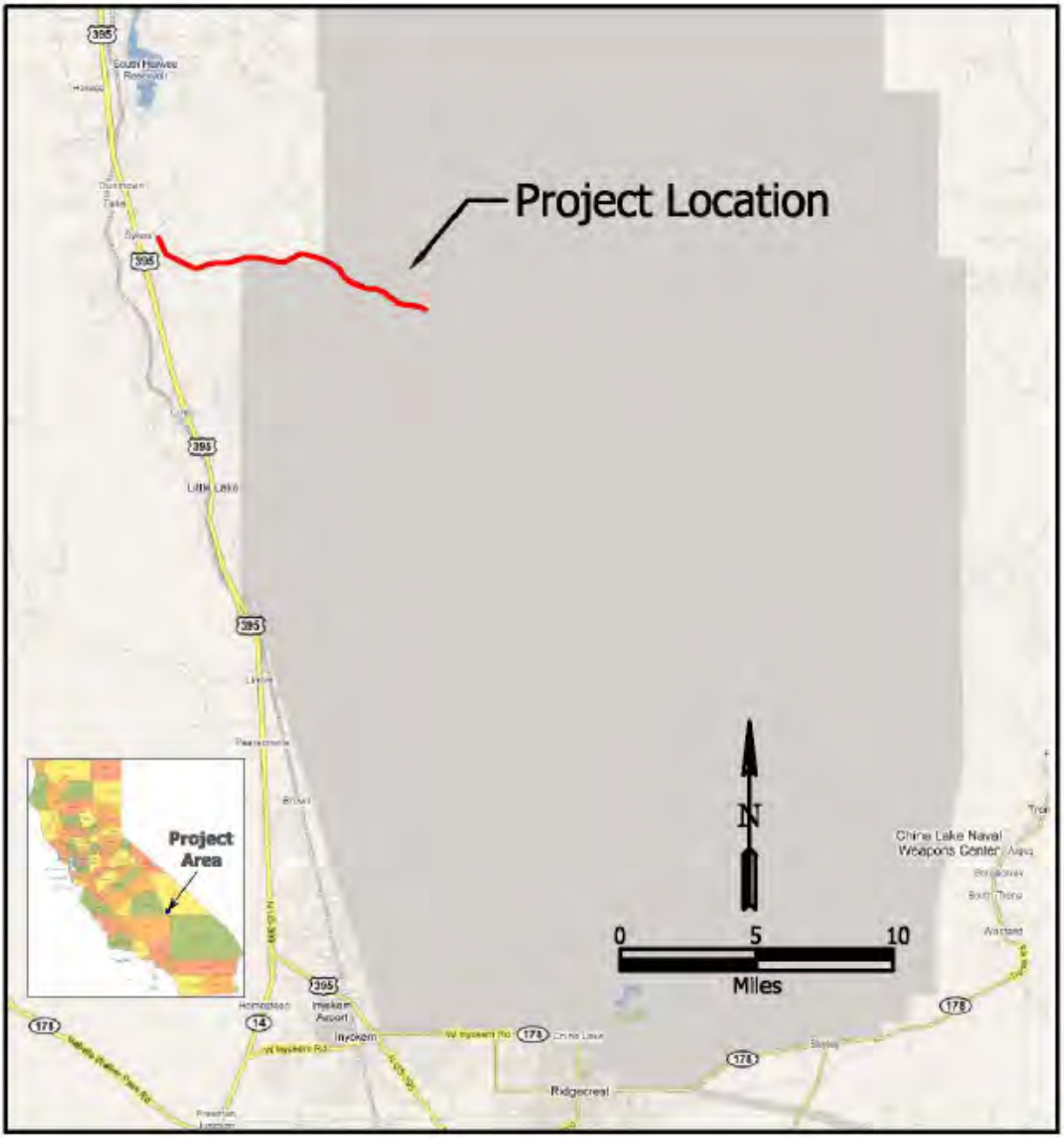

Figure 2. Regional Vicinity

Figure 3. Local Vicinity

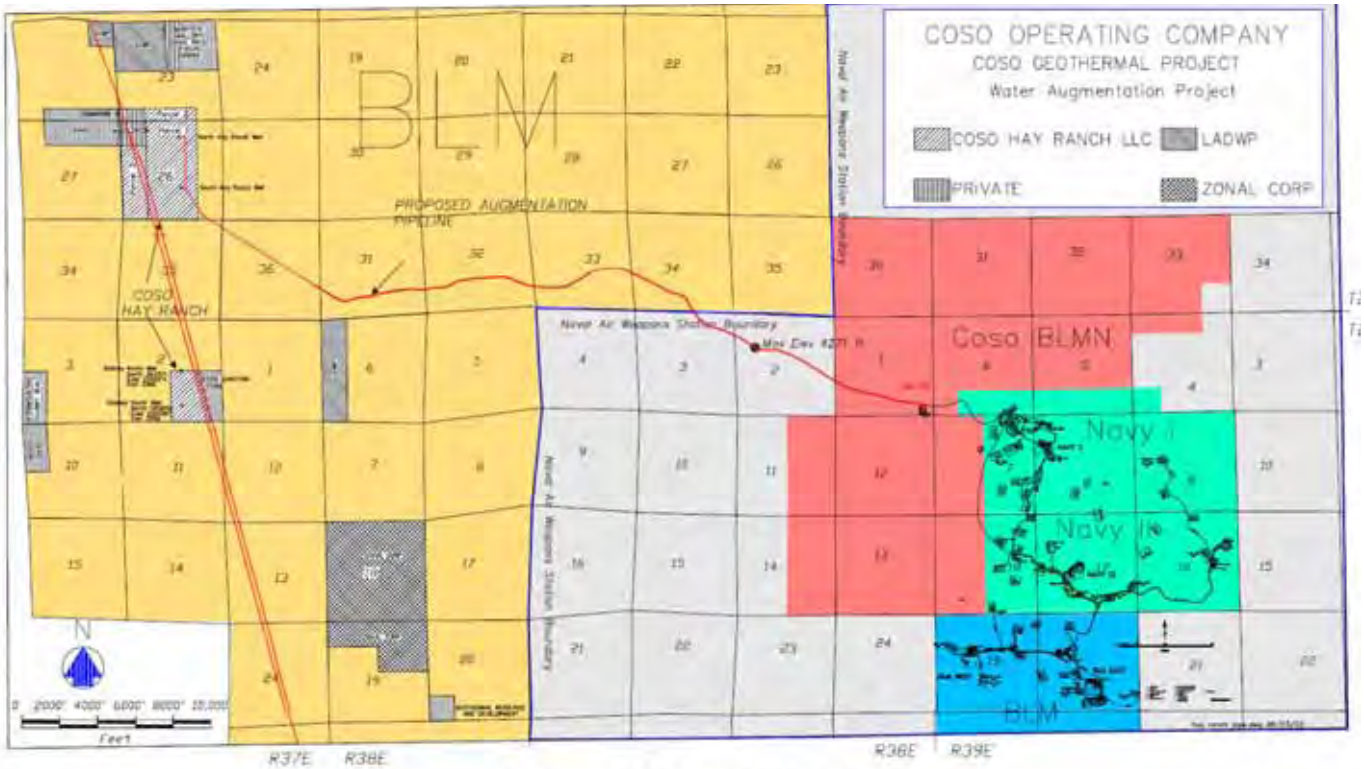

Figure 4. Project Site

3. AFFECTED RESOURCES

The Project is located in the Mojave Desert region of California. Environmental resources in the Project area are described in the *California Desert Conservation Area Plan Environmental Impact Statement (EIS)* (BLM 1980b) and the West Mojave Plan.

BLM has considered the following resources and finds that they are not affected by the Project, and are therefore excluded from this analysis: (1) Prime or Unique Farmlands, (2) Floodplains, (3) Forestry, (4) Fire Management Objectives, (5) Paleontology, (6) Range, (7) Hazardous or Solid Wastes, (8) Wetlands and Riparian, (9) Wilderness, (10) Wild and Scenic Rivers.

3.1 Air Quality

The Project area is located in Inyo County within the Great Basin Valleys Air Basin and is under the regulatory jurisdiction of the GBUAPCD. The basin is bounded by the Mojave Desert Air Basin to the south, the San Joaquin Valley and Mountain Counties Air Basins to the west, Lake Tahoe Air Basin to the north, and the State of Nevada to the east. The basin includes all of Alpine, Inyo, and Mono counties.

Air Quality Standards

Federal and state ambient air quality standards have been established for "criteria pollutants." These pollutants include ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), respirable particulate matter (PM_{10}), fine particulate matter ($PM_{2.5}$), and lead (Pb). In general, the California Ambient Air Quality Standards (CAAQS) are more stringent than the corresponding National Ambient Air Quality Standards (NAAQS). The state has also established ambient air quality standards for sulfates, hydrogen sulfide, vinyl chloride, and particulate matter. Table 3.1-1, National and State Ambient Air Quality Standards, lists the current NAAQS and CAAQS for each pollutant.

Table 3.1-1
National and State Ambient Air Quality Standards

Air Pollutant	Averaging Time	California Standard	National Standard	
			Primary	Secondary
Ozone (O_3)	8 Hour 1 Hour	0.070 ppm 0.09 ppm	0.075 ppm —	— —
Carbon Monoxide (CO)	8 Hour 1 Hour	9.0 ppm 20 ppm	9 ppm 35 ppm	9 ppm 35 ppm
Nitrogen Dioxide (NO_2)	Annual Average 1 Hour	0.030 ppm 0.18 ppm	0.053 ppm	0.053 ppm
Sulfur Dioxide (SO_2)	Annual Average 24 Hour 3 Hour 1 Hour	— 0.04 ppm — 0.25 ppm	0.030 ppm 0.14 ppm — —	— — 0.5 ppm —
Particulate Matter < 2.5 microns ($PM_{2.5}$)	Annual Average 24 Hour	12 µg/m^3, AAM —	15 µg/m^3, AAM 35 µg/m^3	— —
Particulate Matter < 10 microns (PM_{10})	Annual Average 24 Hour	20 µg/m^3, AAM 50 µg/m^3	— 150 µg/m^3	— 150 µg/m^3
Sulfates	24 Hour	25 µg/m^3	—	—
Lead (Pb)	30 Day Calendar Quarter	1.5 µg/m^3	— 1.5 µg/m^3	— 1.5 µg/m^3
Hydrogen Sulfide	1 Hour	0.03 ppm	—	—
Vinyl Chloride (Chloroethene)	24 Hour	0.01 ppm	—	—
Visibility Reducing Particles	1 Observation	Extinction coefficient of 0.23 per kilometer due to particles when relative humidity < 70%, 8-hr. avg. (9 a.m.–5 p.m.)	—	—

Notes: ppm = parts per million; µg/m^3 = micrograms per cubic meter;
AAM = Annual Arithmetic Mean; "—" = no data.
Source: California Air Resources Board 2008.

Existing Air Quality Condition

The Project lies in Inyo County, a portion of the air basin administered by the GBUAPCD. Air quality in the area is generally good. The area is classified as being in attainment, or unclassified due to lack of data, for all NAAQS, and in attainment or unclassified for all CAAQS, except PM_{10}. The area is classified as nonattainment for PM_{10}. Major sources of PM_{10} are wind erosion of crustal material; dust from vehicular traffic on roads; and other sources, such as mining activities.

Federal Conformity*:* A federal conformity analysis is required for any federal action within any federal nonattainment or maintenance area. The proposed Project is located in an area that is classified as nonattainment for $PM_{10.}$

Levels of ambient air contaminants are measured at the California Air Resources Board (CARB) air monitoring stations located throughout the state. Monitoring stations in Inyo County mainly monitor PM_{10} levels. The nearest station to the Project site, Coso Junction–U.S. Highway 395 Rest Area Station, is approximately 2 miles from the Project location, and monitors PM_{10} only. Air quality trends with respect to PM_{10} developed from data collected at that station for the past 4 recorded years are presented in Table 3.1-2 (Air Quality Data at Project Area). Table 3.1-2 indicates that the national PM_{10} standard was exceeded in the last 2 years, and the state 24-hour PM_{10} standard was exceeded every year between 3 to 13 days during the last 4 years.

Table 3.1-2
Air Quality Data at Project Area

Pollutant	California Standard	Federal Standard	Year	Maximum Level (ppm)	State Standard Exceeded (Days)
Particulates, PM_{10} (24-hour)	50 μg/ m^3	150 μg/m^3	2007	N/A	N/A
			2006	77/73	N/A
			2005	99/91	6.1
			2004	66/63	6.1
Particulates, PM_{10} (Annual)	20 μg/m^3 (AGM)	50 μg/m^3 (AAM)	2007	19.4/N/A	No
			2006	14.3/N/A	No
			2005	18.9/16.4	No
			2004	15.1/13.4	No

Notes:
Levels shown for annual PM_{10} are AAM. Maximum levels for PM_{10} shown in μg/ m^3. First value shown is based on federal monitoring method; second value is based on state monitoring method.
N/A = insufficient (or no) data available to determine the value.

Source: Pollutants data were obtained from the following CARB Air Monitoring Station,
PM_{10}: Coso Junction–Highway 395 Rest Area (Inyo) (CARB 2008).

3.2 Soils

Soils in the Project area are generally coarse and rocky. They are derived from either the bedrock substrate or basement rocks in the Coso Range that consist of granitic rocks of Mesozoic age with older metasedimentary and metavolcanic rocks. The Sugarloaf Mountain area, just south of the pipeline alignment, exhibits overlapping volcanic domes and flows with extensive obsidian outcrops. The types of soils found in the Project area include the following (BLM 1980; MHA 2008):

Dunmovin: Somewhat excessively drained, deep, sandy soils formed in alluvium. They are subject to water and wind erosion.

Dunmovin-Lavic-Wasco Variant: Sandy and loamy soils, excessively to well drained, very deep, and formed in alluvium. They have a high potential for wind erosion and are susceptible to water erosion.

Alko Variant-Joshua Variant-Nebona Variant: Shallow to deep, generally sandy and loamy with some clay lenses and silica-cemented hardpans. These soils are well drained and susceptible to wind and water erosion.

Maynard Lake-Stumble: Sandy soils formed in alluvial plains from rhyolite tuff and volcanic ash deposits. These soils are highly porous and drain rapidly. They are subject to moderate water erosion and high wind erosion.

Cosos-Rock Outcrop: Shallow to very shallow units formed in granite outcrops. These soils are stony and loamy and are excessively drained due to rapid runoff. They are highly susceptible to water and wind erosion.

3.3 Vegetation

According to the Department of the Army, U.S. Army Corps of Engineers, and based on surveys conducted by Kleinfelder (2007), no jurisdictional wetlands or other waters of the United States were identified within the project area or along the pipeline corridor.

Three plant communities (as defined by the California Natural Diversity Database (CNDD, CDFG 2003a) and Sawyer Keeler-Wolf (1995)) occur in the Project site: creosote–white bursage scrub; allscale scrub; and agricultural land. Invasive non-native species also occur in the Project site.

A plant survey was conducted on the Project site and found the species identified in Table 3.3-1. No plant species of special concern were identified within the proposed pipeline corridor or elsewhere within the Project site.

Table 3.3-1
Plant Species Observed on the Project Site

Scientific Name	Common Name
Acacia greggii	Catclaw acacia
Ambrosia dumosa	White bursage
Amsinckia tessellata	Bristly fiddleneck
Artemisia spinescens	Bud sage, budsage
Atriplex canescens	Shadscale
Atriplex confertifolia	Spiny saltbush
Atriplex parryi	Parry's saltbush
Atriplex polycarpa	Allscale
Atriplex spinifera	Spinescale
Chrysothamnus teretifolius	Green rabbit brush
Echinocactus polycephalus var. *polycephalus*	Clustered barrel cactus
Ephedra californica	Ephedra
Erigeron compositus	Cut leaf daisy
Eriogonum brachyanthum	Short-flowered buckwheat
Eriogonum inflatum	Desert trumpet
Eriogonum mohavense	Western Mojave buckwheat
Eriogonum nidularium	Birdnest buckwheat
Erodium botrys	Storksbill
Hymenoclea salsola	Cheesebush
Isomeris arborea	Bladderpod
Langoisia schottii	Schott's calico
Larrea tridentata	Creosote
Nama demissum	Purple mat
Opuntia basilaris	Beavertail
Opuntia bigelovii	Teddy bear cholla
Oryzopsis hymenoides	Indian ricegrass
Phacelia bicolor var. *bicolor*	Trumpet phacelia
Phacelia inyoensis CNPS species	Inyo phacelia
Physalis crassifolia	Thick-leaved ground cherry
Ranunculus glaberrimus	Sagebrush buttercup
Salvia carduacea	Sage thistle
Salvia columbariae	Chia
Sphaeralcea ambigua	Desert mallow
Suaeda calceoliformis	Pursh's seepweed
Yucca brevifolia	Joshua tree

3.3.1 Creosote–White Bursage Scrub

Creosote–white bursage scrub is a series within Mojave creosote bush scrub. In creosote–white bursage scrub, creosote bush and white bursage are equally important, and brittlebush can be a third common species. Mojave creosote bush scrub is the most extensive cover type in the Mojave Desert region, covering 57% of the land's surface (BLM 2003). Perennial shrubs are generally widely spaced in creosote bush scrub, usually with bare ground between them. Plant growth occurs during spring and is prevented by winter cold and seasonal drought. Many species of ephemeral herbs may flower in late March and April if the winter rains are sufficient.

Creosote–white bursage scrub on the Project site contains widely spaced creosote bushes (*Larrea tridentata*) with white bursage shrubs (*Ambrosia dumosa*) as co-dominants. Creosote–white bursage scrub also contains teddy bear cholla (*Opuntia bigelovii*), beavertail cactus (*Opuntia basilaris*), and scattered Joshua trees (*Yucca brevifolia*).

3.3.2 Allscale Scrub

Allscale scrub is often considered part of the saltbush scrub series with allscale (*Atriplex polycarpa*) as a dominant species. Saltbush scrub is an assemblage of low, grayish shrubs, 1 to 4 feet tall, with some succulent species. Allscale series occurs with different associates regionally, as suggested by CNDDB categories. Total ground cover is often low, with bare ground between perennial plants.

Allscale scrub on the Project site is generally undisturbed with a developed understory. It contains bristly fiddleneck (*Amsinckia tessellata*), shadscale (*Atriplex canescens*), green rabbit brush (*Chrysothamnus teretifolius*), ephedra (*Ephedra californica*), desert trumpet (*Eriogonum inflatum*), cheesebush (*Hymenoclea salsola*), and numerous other plant species as shown in Table 3.3-1, Plant Species Observed on the Project Site.

3.3.3 Agricultural Land

The western portion of the Project site is agricultural land that is currently fallow. The agricultural land was used until the late 1980s to grow alfalfa (*Medicago sativa*), and possibly other crops, using an estimated 3,000 acre-feet of groundwater per year to irrigate approximately 511 acres (6 feet per acre per day) (G. Harris, pers. comm. 2008).

3.3.4 Invasive Species

Invasive species have been identified by the BLM. These species are non-native, undesirable species that are aggressive and are overly competitive with more desirable native species. In

2005, the BLM established an integrated non-native vegetation management program to address these species in their Programmatic EIS.

Inventory work conducted over the last several years has detected more than 20 species of noxious/invasive weeds on or adjacent to public lands within the Ridgecrest Field Office's area of jurisdiction. Several of those species occur on or adjacent to the Project area; however, this analysis did not identify any noxious species directly on the proposed alignment.

3.4 Hydrology

This section is summarized in part from the Hydrology and Water Quality section prepared by Inyo County in their Draft EIR for the Conditional Use Permit (CUP 2007-003) (MHA 2008).

3.4.1 Surface Water

There are no perennial watercourses within the Project area or surrounding region. All streams and areas of standing water are intermittent (flow occurring only as a result of seasonal runoff) to ephemeral (flow occurring only during and immediately after a precipitation event). During heavy runoff events, water carries sand, gravel, cobbles, and occasionally boulder-sized rocks down slope in washes as part of the bed load transport. Deposition of this bed load material across areas of less steep terrain has resulted in the formation of alluvial fans, which are common in portions of the Project area.

Major surface water resources within the vicinity that may relate to the Proposed Action include South Haiwee Reservoir (9.4 miles north of the Proposed Action site); Little Lake and its associated springs (approximately 9 miles south of the Hay Ranch site); and several springs in Rose Valley, including Rose Valley, Tunawee Canyon, Davis, Little Lake Fault, and Coso springs.

3.4.2 Groundwater

The groundwater table in Rose Valley ranges from 140 to 340 feet below ground surface in the northern and central parts of the valley to approximately 49 feet below ground surface in the southern end of the valley at Little Lake Ranch. Figure 5, Groundwater Contours, provides a depth to groundwater contour map developed from depth to groundwater measurements made on November 19, 2007.

Groundwater generally flows to the southwest in the valley. Because the ground surface slopes more steeply to the south of Rose Valley than the groundwater table, the groundwater surfaces from springs beneath Little Lake, sustaining the lake and the surface water, and discharges across the Little Lake weir.

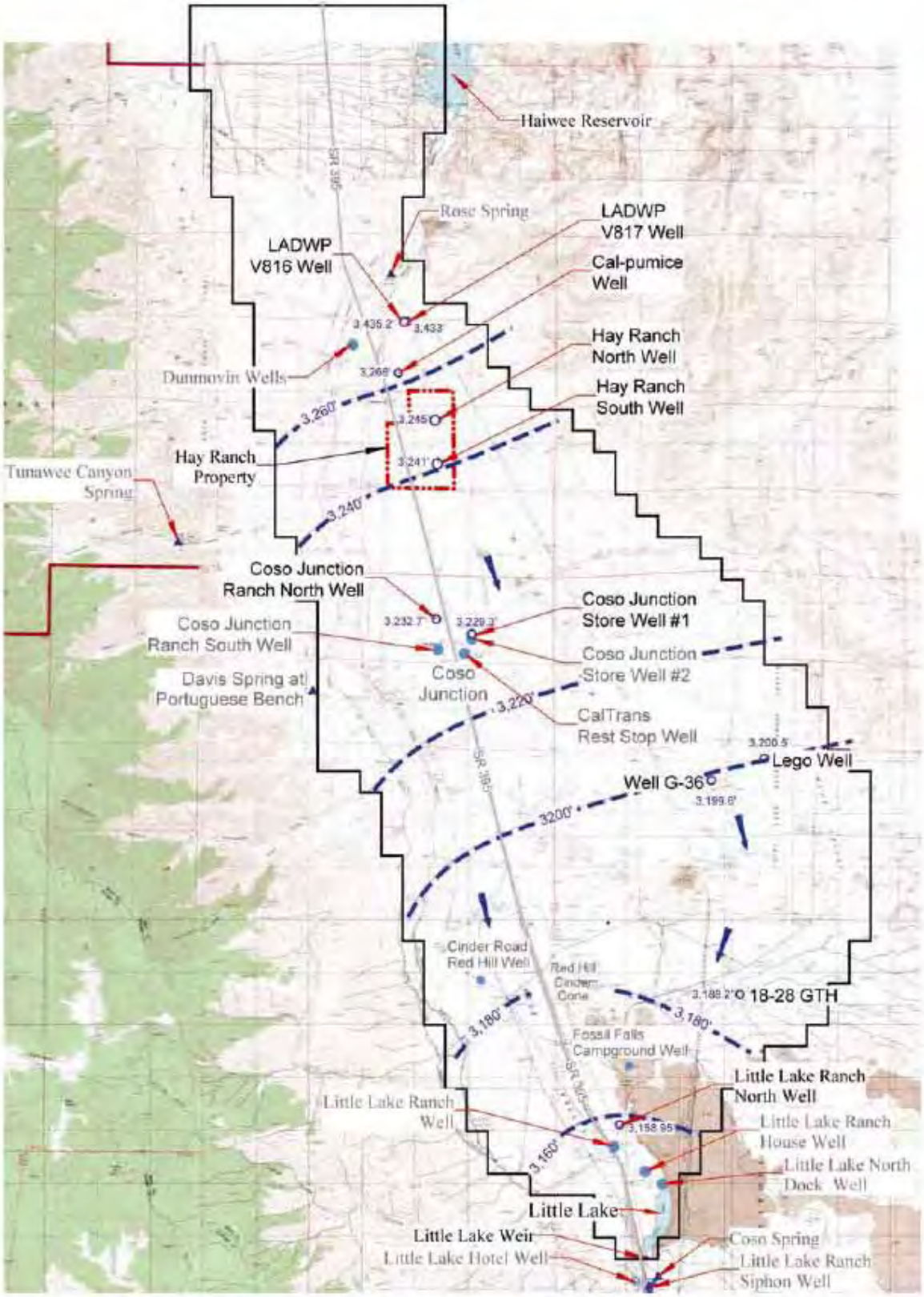

Figure 5. Groundwater Contours

Source: MHA, 2008

Groundwater quality in Rose Valley near the Hay Ranch is characterized by total dissolved solids (TDS) between 800 and 900 mg/L. TDS within the southern Rose Valley is from 500 to 700 mg/L.

3.5 Wildlife Habitat

Complex plant communities with numerous vegetation layers and a variety of plant species create a viable habitat for many wildlife species. These communities provide the wildlife with nesting and denning sites, escape cover, and protection from adverse weather.

The creosote bush scrub and plant communities in the Proposed Action area are expected to support many common desert species. These species include a wide variety of reptiles, mammals, and birds.

3.5.1 Special-Status Wildlife Species

A review of current literature identified potential special-status plants, wildlife, or sensitive communities known within the vicinity of the Project site. The review included the California Native Plant Society's (CNPS's) Electronic Inventory of Rare and Endangered Vascular Plants of California (2001), CalFlora Database (2000), compendia of special-status species published by CDFG (2003b, 2003c), and the CDFG CNDDB (2004) for the Coso Junction and Cactus Peak 7.5-minute series topographic quadrangles, and surrounding quadrangles (Haiwee Pass, Haiwee Reservoirs, Upper Centennial Flat, Coso Peak, Long Canyon, Petroglyph Canyon, Sacatar Canyon, Little Lake, Volcano Peak, and Airport Lake).

Special-status species include the following:

1. Species listed as Threatened or Endangered under the Federal Endangered Species Act (Federal ESA);

2. Species proposed for listing as Threatened or Endangered under the Federal ESA;

3. Species listed by the State of California as Threatened, Endangered, or Rare under the California Endangered Species Act (CESA);

4. Species proposed for listing as Threatened or Endangered under the CESA;

5. Fully protected animals in California (CDFG Code, Sections 3511 (birds), 4700 (mammals), and 5050 (reptiles and amphibians)); and

6. BLM Sensitive Species.

From the database reviews, eight special-status wildlife species were identified with the potential to occur on or in the immediate vicinity of the Project site: pale big-eared bat *(Corynorhinus townsendii pallescens)*, Mohave ground squirrel *(Spermophilus mohavensis)*, desert tortoise *(Gopherus agassizii)*, Kern plateau slender salamander *(Batrachoseps robustus* sp.*)*, Owens Valley vole *(Microtus californicus vallicola)*, and Wong's springsnail *(Pyrgulopsis wongi)*.

A 50-foot-wide temporary construction corridor along the proposed pipeline alignment (approximately 9 miles) was surveyed for signs of special-status species with a focus on desert tortoise and Mohave ground squirrel. Surveys were conducted on foot by two qualified biologists, Miller and Laberteaux, by meandering and intersecting transects. An additional 50 feet (25 feet on each perimeter) were surveyed by random meandering transect by one qualified biologist (Laberteaux). The pipeline alignment survey corridor was searched for signs of desert tortoise, including scat, palettes, and old carapaces (i.e., tortoise shells). Wildlife and any signs were identified and catalogued.

On the basis of the pedestrian surveys, only the desert tortoise and the Mohave ground squirrel are considered to potentially occur on the Project site. The pale big-eared bat may forage over the site; however, because of the absence of suitable roost sites, the pale big-eared bat is not expected to roost on the Project site. The Kern plateau slender salamander, the Owens Valley vole, and Wong's springsnail are not expected to occur on site due to the absence of suitable habitat.

Mohave Ground Squirrel (California Threatened Species)

Mohave ground squirrels were not observed during the field surveys. No trapping was conducted. Burrows of appropriate size for Mohave ground squirrel were found during the surveys.

The Mohave ground squirrel is known to occur within the CLNAWS boundary (Leitner 2007) and is expected to occur on the Project site in creosote–white bursage scrub and desert saltbush scrub habitats.

Desert Tortoise (Federal and California Threatened Species)

Desert tortoises were not observed during the field surveys conducted in 2005 by UltraSystems. Burrows ranging in size from approximately 5 to 12 inches in diameter, consistent with that known for desert tortoise, were flagged and examined along the proposed pipeline route approximately 50 meters from the existing road. The flagged potential burrows were of poor quality and found to be partially collapsed or not in active use. A survey for the proposed Coso Road Improvement project was conducted in 2007. This survey produced 20 signs of desert tortoise, including one tortoise scat that was considered less than 1 year old. Although no

tortoises were found, this survey indicated that the area is suitable desert tortoise habitat presumably supporting very low numbers of tortoises. With the new information, BLM has requested formal consultation from the USFWS regarding the desert tortoise within the Project area (Appendix B of this EA).

3.5.2 Other Special-Status Species

Charlotte's Phacelia (BLM Special Status; CNPS Sensitive)

At lower elevations, Charlotte's phacelia is found in Mojave Desert scrub with creosote bush, beavertail cactus, and burrobush.

Charlotte's phacelia may occur on the Project site but was not found during the surveys.

Darwin Mesa Milk-Vetch (BLM Special Status; CNPS Sensitive)

Darwin mesa milk-vetch is found in desert mountains (north and west of Panamint Valley, Inyo County) and occurs at elevations of 4,288 to 7,408 feet above mean sea level (amsl). It is found in a variety of habitats including pinion pine, pinion–juniper woodland, sagebrush scrub, and Joshua tree woodland and is usually found on volcanic clay or gravelly substrates.

Darwin mesa milk-vetch is not expected to occur on the Project site since the Project area does not contain its habitat. It was not found during the surveys.

Sanicle Cymopterus (CNPS Sensitive)

Sanicle cymopterus is a small perennial herb from a buried root crown. It grows in loose soils that can be sandy to gravelly, often somewhat alkaline, on volcanic tuff deposits and mixed valley alluvium. It typically inhabits small drainage-ways, in the blackbrush, mixed-shrub, sagebrush, and lower pinion-juniper zones. It has been observed at elevations of 3,150 to 6,720 feet amsl.

Sanicle Cymopterus may occur on the Project site but was not found during the surveys.

Inyo Hulsea (BLM Special Status; CNPS Sensitive Species)

Inyo hulsea occurs between elevations of 4,600 and 7,300 feet amsl. It is found on steep, unstable, sandy or rocky slopes and sometimes in washes in high desert shrublands and pinion woodlands. Associated species include big sagebrush, saltbush, rabbitbrush, single-needle pinion, and antelope brush.

This species may occur within the Project boundaries at the higher elevations but was not found during the surveys.

Pinion Rock Cress (CNPS Sensitive Species)

Pinion rock cress can be found in Joshua tree woodland, pinion-juniper woodland, Mojave Desert scrub, and creosote brush scrub. It occurs in Inyo, Mono, San Bernardino, and Tulare counties. It is found at elevations of 3,940 to 7,870 feet amsl in habitats that have granitic, gravelly slopes and mesas. Pinion rock cress is often found under desert shrubs, which support it as it grows.

Pinion rock cress may occur on the Project site in the higher elevations of creosote–white bursage scrub, but was not found during the surveys.

Creamy Blazing Star (CNPS Sensitive Species)

Creamy blazing star is found in central Mojave Desert scrub, specifically creosote bush scrub at elevations of 2,300 to 3,800 feet amsl.

Creamy blazing star may occur on the Project site, but was not found during the surveys.

Crown Mullia (CNPS Sensitive)

This species has a high potential to occur in the Project area. Only three plants were observed in the surveys; those were located outside the proposed pipeline corridor.

Death Valley Birdgrass (CNPS Sensitive)

This species has potential to occur within the washes of the Project area.

Pale Big-Eared Bat (California Species of Concern)

The pale big-eared bat may forage over the site. However, because of the absence of suitable roost sites, the pale big-eared bat is not expected to roost on the Project site.

Owens Valley Vole (California Species of Concern)

The Owens Valley vole, a subspecies of the California vole, is found in the Owens Valley and areas to the south (CDFG 2004). Voles breed throughout the year and reach population peaks if food and cover are abundant. Voles forage on the ground, feeding on leafy parts of grasses, sedges, and herbs. They clip grasses and forbs at the base, which form a network of runways around their burrows. The Owens Valley vole is found in wetlands and dense grass habitats in the Owens Valley (CDFG 2004). The CNDDB documents there were 12 occurrences of the Owens Valley vole, ranging from the Bishop area in the north to Little Lake in the south.

Although the site is within the historic range of the Owens Valley vole, the vole is not expected to occur in the Project area due to the absence of suitable habitat.

3.6 Cultural Resources

An extensive cultural resources study was conducted of the Project's APE during May 2004 by ASM Affiliates of Carlsbad, California. Mark S. Becker, PhD. and Brian F. Byrd, PhD. served as principal investigators. Mr. Drew Pallette, of ASM Affiliates, served as a crew member and Mr. Richard Stewart of Big Pine, California served as a representative for the Fort Independence Reservation and participated in the survey. Their report, *Cultural Resources Inventory for the Hay Ranch Water Extraction and Delivery System, Coso Geothermal Project, Inyo County, California*, was submitted in May 2005. After providing an introduction to the Proposed Action, the report presents background data on the prehistory, history, and Native American inhabitants of the area, followed by a summary of pre-field research findings, and descriptions of what the field work discovered.

The APE for their intensive level (transect intervals of 5 meters) field coverage was defined as a corridor 50 feet wide (15 meters), centered on the centerline of the proposed pipeline route. The length of the survey was 8 miles (13 kilometers) from the North Well, located near U.S. Highway 395 in the Rose Valley, to injection well 88-1 located on the CLNAWS.

As a result of the field reconnaissance of the APE by ASM Affiliates, six archaeological sites and seven isolates were recorded. These include four previously known sites (designated as CA-INY-1863, CA-INY-2125, CA-INY-3406, and CA-INY-4413) and two newly discovered sites (designated as CGP-1 and CGP-2). These six sites represent one historic and five prehistoric use areas. Two sites, CA-INY-2125 and CA-INY-4413, occur within the CLNAWS and are contributing elements to the proposed Sugarloaf Archaeological National Register District, while four sites (CA-INY-1863, CA-INY-3406, CGP-1, and CGP-2) occur on BLM public land, and as allowed by the October 2007 State Programmatic Agreement (Paragraph V.E.4.) between BLM, SHPO, and the ACHP, are being treated as if they are eligible for the National Register of Historic Places (NRHP).

The seven isolates recorded include six on BLM land and one on the CLNAWS. In addition, it was conclusively established that three previously recorded sites, CA-INY-4412 (within the CLNAWS), CA- INY-2248, and CA-INY-3002 do not extend into the Project's APE.

The two sites on the CLNAWS (CA-INY-2125 and CA-INY-4413) were previously subjected to limited test excavations and were recommended as eligible for the NRHP. Subsequently, they were included as contributing properties of the proposed Sugarloaf Archaeological National Register District. One site on BLM land, CA-INY-1863, was recommended as eligible for the

NRHP by ASM Affiliates, while the other three sites (CA-INY-3406, CGP-1, and CGP-2) were not evaluated by the consultant.

The extent, character, and portion of each site that falls within the Project's APE varies considerably. Table 3.6-1, Summary of Sites Identified within the Project APE, is based upon Table 6.1 of ASM Affiliates' report (page 50), and summarizes the sites and the eligibility status of each for the NRHP.

Table 3.6-1
Summary of Sites Identified within the Project APE

Site Number	Description	Size of Portion within APE	Eligibility Status
CLNAWS-Managed Lands			
INY-2125	Prehistoric lithic scatter	656.2 ft x 49.2 ft (32,285.0 ft^2)	Contributing property to the Sugarloaf Archaeological District
INY-4413	Prehistoric lithic scatter with metals	492.1 ft x 49.2 ft (24,211.3 ft^2)	Contributing property to the Sugarloaf Archaeological District
BLM-Managed Lands			
INY-1863	Prehistoric scatter with midden, metals, and bedrock mortars	656.2 ft x 49.2 ft (32,285.0 ft^2)	Recommended eligible by consultant
INY-3406	Prehistoric flake and lithic tool scatter with milling slick	75.5 ft x 16.4 ft (1,238.2 ft^2)	Not evaluated by consultant
CGP-1	Historic site with features and trash concentrations	328.1 ft x 49.2 ft (16,142.5 ft^2)	Not evaluated by consultant
CGP-2	Prehistoric flake scatter	419.9 ft x 147.6 ft (78,119.8 ft^2)	Not evaluated by consultant

SOURCE: MHA 2007; ASM 2005.

Additionally, site CA-INY-3002, which is outside the Project APE, was the subject of test investigations as part of the study by ASM Affiliates. The site, which was originally thought to occur within the Project APE, was found instead to lay outside the APE as a result of the test investigations conducted by Far Western Anthropological Research Group, Inc., during January 2005.

While this EA was being prepared by BLM, during the summer of 2007, the Inyo County Department of Public Works contracted with the Reno branch office of ASM Affiliates to conduct a field reconnaissance of Gill Station Road from its junction with U.S. Highway 395 and the CLNAWS boundary line. The purpose of this study was part of Inyo County's planning efforts to improve the physical condition of the road. The width of this second survey was over 200 feet (60 meters) and centered on the centerline of Gill Station Road. This is much wider than

the width of the 2004 survey of the proposed Hay Ranch Project pipeline corridor, which was 50 feet (15 meters).

This second survey by ASM Affiliates recorded 11 new archaeological sites, and relocated and updated site records for four previously known sites, including one of the six sites recorded by the 2004 ASM Affiliates study. However, none of the 11 newly discovered archaeological sites, and only one of the three re-recorded sites occur within the APE for the Hay Ranch Project pipeline. The boundary line for site CA-INY-1863 though was expanded by the 2007 ASM Affiliates survey.

3.6.1 Native American Values

The Eastern Sierra and Mojave Desert regions have been the home of many distinct and diverse groups of Native Americans for over 10,000 years. Tribal communities are currently located at Bishop, Big Pine, Fort Independence, Lone Pine, and Furnace Creek in Death Valley. In spite of 175 years of interaction with the larger American society, these communities still maintain their tribal identity and culture fairly intact. Part of their culture is religious values often tied to particular geographic landmarks and locations. One such area of special religious and spiritual affinity is Coso Hot Springs, which is listed on the NRHP, and since 1945 has been located within the CLNAWS and is part of the APE for this Project.

3.7 Visual Resources

The proposed alignment is located within an area containing a low-growing desert scrub area that contains some roadways and power lines. The hills serve as a background for the area.

While the CDCA Plan states that projects such as this do not impact visual quality of Class M lands, the BLM chose to use its Visual Resource Management (VRM) guidelines to evaluate visual resources and assess the potential impacts of constructing and operating a water delivery project. Data collected to perform this analysis included USGS quadrangle maps, aerial photographs, surface photographs, and project maps. The BLM guidelines have four factors to consider in evaluating a view: scenic quality rating, sensitivity level, distance zones, and visual resource classes and objectives.

- **Scenic Quality Evaluation** measures the visual appeal of a tract of land. In the visual resource inventory process, lands are given an A, B, or C rating based on the apparent scenic quality, which is determined using seven key factors: landform, vegetation, water, color, adjacent scenery, scarcity (common or rare), and cultural modifications. The rating system assumes that areas with the most variety and the most harmonious composition have the greatest scenic value. The system also assumes that features of the human environment do not necessarily detract from the scenic value of the landscape. The rating totals are used to

classify the scenic quality as: Class A, outstanding; Class B, a combination of outstanding and common; Class C, fairly common to the physiographic region.

- **Sensitivity Level Analysis** takes into consideration the frequency of use of an area and the user's perceived degree of concern about proposed changes in scenic quality. Each area is rated as having high, medium, or low sensitivity. Sensitivity level analysis is used as an estimate of public concern for scenic quality. Six factors are used to evaluate sensitivity: types of users, amount of use, public interest, adjacent land uses, special land use areas, and other factors (e.g., research or studies indicating visual sensitivity). Each factor is assigned a rating of high, medium, or low, then an overall rating is given based on the ratings for the six factors.

- **Distance Zones** are based on the level of visibility of the proposed corridor within the landscape from major viewing routes and observation points. Distance zones allow the consideration of the proximity of the observer to the project features. A particular scene is assigned one of three ratings. Foreground/middle ground includes areas seen from highways, rivers, or other viewing locations to a distance of 3 to 5 miles. Background includes areas beyond the foreground/middle ground but usually less than 15 miles away. Seldom seen areas are those that are normally hidden from view.

- **Visual Resource Classes and Objectives** are assigned four categories, or classes (I through IV). The categories are assigned through two tools, including an inventory tool that portrays the relative value of the visual resources and a management tool that portrays the visual management objectives. There are four classes; Class I is for complete preservation of the exiting landscape and Class IV is for areas that could be altered to provide for BLM management activities.

3.8 Outdoor Recreation and Open Space

The California desert provides the resources necessary for a variety of recreational experiences. The BLM is committed to providing opportunities for the visitor to obtain various types of outdoor recreational experiences and benefits dependent upon a combination of: (1) the kind of activity desired, (2) the physical or regional setting, and (3) the level of experiences (psychological and/or physiological). BLM considered a variety of recreational opportunities along a continuum of opportunities ranging from intensive motorized-vehicle-oriented activities to resource-oriented activities.

Open Space Areas **–** The Proposed Action serves as open space for the residents in the general area.

Recreational Activities **–** The California desert's natural value provides many avenues for people to explore their recreational interests.

There is a wealth of geological areas to lure the rockhound and hobby prospector. Hunters find the desert a challenge for game species from quail to mule deer.

Sightseers, painters, and photographers have long known the recreational delights of spectacular spring wildflower displays and year-round birdwatching.

Motorized vehicle travel is used as a recreational pursuit, itself, and to provide access to pursue other recreational opportunities.

Regardless of the methods available to participate in desert recreation, provisions to ensure that these opportunities will continue must be a constant concern of both management and desert users.

3.9 Social and Economic Value

Inyo County's economy is primarily driven by two economic sectors: tourism, and resource extraction and management. Each sector is summarized below:

Tourism. The county budget derives 7% of its total revenues from tourism-related taxes, including sales, occupancy, and use taxes. Tourism is the most important component of Inyo County's economy. Visitor spending (i.e., dollars brought into the county from outside and spent here) boosts local business income and personal income in addition to tax revenues. Tourists contribute 70% of all retail and lodging purchases in the county and are the most important economic resource in the county's economy.

Resource Extraction and Management. A significant portion of Inyo County's economy includes agriculture, grazing, and mining activities, as well as water transportation and management. These activities are expected to continue long term, and are expected to remain stable into the future.

Mining activities in the county extract common minerals such as sand, gravel, clay, borates, and perlite. Public agencies, such as Caltrans and Inyo County, are the largest users of these minerals, and the related employment contributes both to the county's economy and to local infrastructure. Future mineral price fluctuations and international political events will continue to affect the mining industry in Inyo County.

Inyo County Communities in the Vicinity of the Proposed Action

Inyo County communities located closest to the Proposed Action include the following:

Coso Junction. Coso Junction, located approximately 2 miles south of the South Well on the hay ranch parcel. It includes a small highway commercial development, mobile home park, and a fallow hay ranch. It operates as a safety rest area along U.S. Highway 395 and has a population of less than forty.

Dunmovin. Dunmovin is a rural community located approximately 0.5 miles northwest of the Hay Ranch parcel. It consists of unused commercial buildings and a ten-parcel subdivision. The community has a population of five.

Little Lake. Little Lake is located approximately 9 miles south of the Hay Ranch. It is a rural commercial area that contains a few scattered residential units. The population of Little Lake is less than ten (Inyo County 2001).

Haiwee. Haiwee is a widely dispersed residential community located 7 miles north of the Hay Ranch and covers 2,100 acres. It has a population of 20 (MHA 2008).

Olancha. Olancha is a rual community located at the intersection of U.S. Highway 395 and State Route 190. The community includes a clay processing mill, Crystal Geyser water bottling plant, and other light industrial facilities. The area surrounding Olancha is used for cattle grazing and alfalfa crops. It has a population estimated at 530.

Inyo County General Plan Consistency

The Economic Development Element of the Inyo County General Plan created policies to support the county's long-term efforts to improve economic conditions for all county residents.

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4. ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION

This section describes the potential environmental impacts of the Proposed Action, including the direct, indirect, and cumulative impacts. Mitigation measures are identified for any potentially significant impact. These mitigation measures are expected to reduce the potentially significant impacts to less than significant levels.

For purposes of the cumulative impact analysis included in the evaluation of the potential environmental consequences of the Proposed Action, the following potential projects were considered in addition to the Proposed Action.

Los Angeles Department of Water and Power Haiwee Reservoir Seepage Recovery

The LADWP's North and South Haiwee Reservoirs are unlined and may leak water that infiltrates to the groundwater table. The amount of leakage is unknown. LADWP reportedly estimated the leakage rate to be approximately 900 acre-feet per year, based on the model calibration effort conducted for the 2006 numerical groundwater flow model. LADWP has stated that it will propose a future seepage recovery project that would pump the groundwater from an existing LADWP well (V817 or V816) just north of Hay Ranch through a 1,700-foot-long pipeline to the Los Angeles Aqueduct to the west. The well would be pumped at approximately 1.2 cubic feet per second (870 acre-feet per year). South Haiwee Reservoir's southern extent is located approximately 4 miles north of Hay Ranch; the LADWP's existing wells are located approximately 2.5 miles south of the reservoir and roughly 1 mile north of Hay Ranch.

Little Lake Habitat Restoration Project

Little Lake Ranch, Incorporated (LLR), a privately owned duck hunting club, started a habitat restoration project over 7 years ago at its Little Lake property, located approximately 9 miles south of the Hay Ranch property. The project has created 90 acres of lacustrine[1] habitat (open water), 10 acres of palustrine[2] emergent wetlands, and about 6 acres of palustrine forested habitat (along a 1.6-mile-long creek corridor). The project also enhanced about 220 acres of wetlands-associated uplands and LLR acquired 1 acre of palustrine emergent wetland and associated upland habitats.

The habitat restoration project included installation of a small weir to provide better water management capabilities, removed sediment and non-native vegetation, established native riparian habitat, reconstructed certain basins and stream capabilities, established native food and cover for upland species, and restored wetlands habitat.

[1] Lacustrine is a term used to describe a lake environment.
[2] Palustrine is a wetland classification that includes all non-tidal wetlands, inland wetlands lacking flowing water, or wetlands containing ocean salts in low concentrations.

BLM has approximately 10 acres of public lands surrounding and extending into the middle of Little Lake. This area has a scenic area lookout above the lake that can be accessed by way of Fossil Falls.

Gill Station Road Improvements

Inyo County Department of Public Works proposes to make improvements along a 5.5-mile section of Gill Station Road, from U.S. Highway 395 at Coso Junction to the entry gate for CLNAWS, in southern Inyo County. The project would include realigning, widening, and repaving Gill Station Road.

Crystal Geyser Plant

A new water pumping and water bottling plant is proposed for construction by Crystal Geyser and would be located 3 miles south of Olancha (approximately 11 miles north of Hay Ranch). Construction of the plant is expected to occur late in 2008. Operation of the plant would involve pumping approximately 106 acre-feet per year of groundwater.

Deep Rose Geothermal

Deep Rose, LLC is conducting exploration for geothermal resources in southern Inyo County. If a resource is located, Deep Rose, LLC would apply for permits for geothermal development. The area of exploration is located in the southern McCloud Flat region within Section 16, Township 21 South, Range 38 East, Mount Diablo Base and Meridian. This is located 5.75 miles northeast of Hay Ranch.

U.S. Highway 395

Caltrans has various improvement projects located along or on U.S. Highway 395. Most applicable in this analysis is the safety roadside rest area (SRRA) at Coso Junction. The SRRA rehabilitation project at Coso Junction, located approximately 2 miles south of Hay Ranch, was scheduled to commence construction in November 2007 and was completed in October 2008.

4.1 Air Quality

4.1.1 Impacts

Emissions from the Proposed Action would come from both direct and indirect sources. Direct emissions would come from vehicle use on the access roads, heavy equipment operation, and material handling in the form of PM_{10} emissions. The operation of engines to power the operation would generate particulate and other combustion emissions. Indirect emissions would occur in the form of increased fugitive dust during windstorms due to the soil disturbance as a result of the Proposed Action. All of these activities would be short term and of low intensity. As a result, the overall emissions from the Proposed Action will be minimal; however, there could be local short-term violations of the GBUAPCD rules for fugitive dust if control measures are not applied. No significant off-site impacts are anticipated.

Consistency with the Applicable Air Quality Plan

A project is deemed inconsistent with an air quality plan if it would result in population and/or employment growth that exceed growth estimates included in the applicable air quality plan.

The project would include installation of a nine-mile underground pipeline and water collection tanks. The two existing North and South Water wells at the Coso Hay Ranch will be the sources of the water. The southern well will be tied into the pipeline. Water from the collection tank would be piped to the existing Coso Geothermal Project to the east. The Proposed Action will not result in either an increase in the general population or in the number of employees and staff in the area.

Therefore, the Proposed Action would be consistent with the local general plan and the Regional Growth Management Plan; it is not of regional interest and would be consistent with the 2003 Air Quality Management Plan (AQMP). Hence, no impact would result from Project implementation.

Violation of Air Quality Standard or Contribution to an Existing Air Quality Violation

Air quality impacts are usually divided into perceived short-term and long-term impacts. Short-term impacts are usually the result of construction or grading operations. Long-term impacts are associated with the build-out condition of the Proposed Action.

Short-Term Construction Impact

Construction emissions associated with the Project would be generated for a period of three to five months. Construction emissions can be distinguished as either on or off site. On-site air pollutant emissions during construction would principally consist of exhaust emissions from heavy-duty construction equipment, such as excavators and graders, as well as fugitive particulate matter from soil disturbed during activities such as trenching and grading operations.

Estimates of emissions associated with construction and operation of the Project were calculated using the URBEMIS 2007 Air Quality Model (Version 9.2.4). URBEMIS 2007 estimates maximum daily emissions during four construction periods ranging from 20 to 50 days in duration. Emissions resulting from the operation of two diesel-powered portable generators are discussed in the Long-Term Operational Impacts section of this EA.

Model inputs were modified to reflect construction details provided in the proposed Project description. Data input applied in the URBEMIS 2007 air quality modeling were obtained from the proposed Project application materials that detailed construction equipment information, specifying types and hours per day of operation, as well as timelines for construction phases. Where information was not available, URBEMIS model default assumptions were used. These results are identified in Table 4.1-1, Estimated Maximum Daily Construction Emissions.

Table 4.1-1
Estimated Maximum Daily Construction Emissions

	Unmitigated Emissions (lbs/day)					
	ROG*	NO_x	CO	SO_2	Total PM_{10}	Total $PM_{2.5}$
Construction Period 1 (50 days)	7.05	58.85	23.41	0.00	2.86	2.63
Construction Period 2 (20 days)	2.59	22.60	9.06	0.00	1.05	0.97
Construction Period 3 (50 days)	4.17	35.89	13.56	0.00	1.69	1.55
Construction Period 4 (30 days)	6.81	55.02	25.06	0.00	2.77	2.55

SOURCE: URBEMIS 2007 version 9.2.4.
NOTES: * ROG = Reactive Organic Gas.
See Appendix F, Air Quality Tables, for calculations.

Equipment Exhaust Emissions

Construction equipment, on-road heavy-duty trucks, and construction worker commute vehicles would generate air pollutant emissions. Short-term generation of criteria pollutants would result from the employment of heavy-duty trucks, dozers, trenchers, loaders, and welders that would be used to develop the proposed pipeline and water tanks. The URBEMIS model was customized to reflect operation of specific construction equipment, as illustrated in the detailed model results presented in Appendix F of this EA. Emissions from construction worker commute trips would be minor compared to the emissions generated by construction equipment. The GBUAPCD considers short-term construction exhaust emissions to be less than significant. Because this impact is less than significant according to the criteria presented above, mitigation measures to mitigate construction equipment exhaust emissions are not required.

Fugitive Dust (PM_{10}) Emissions

Fugitive dust emissions in the form of PM_{10} (particulate matter up to 10 microns in diameter) would be a factor during clearing, grading, trenching, and other ground-disturbing construction activities. Quantitative values could vary significantly depending on soil moisture, silt content, wind speed, construction density, and other factors. Construction of the proposed Project would entail the application of water to exposed soil to reduce fugitive dust generation. The use of 4,000-gallon water trucks during each construction phase is represented in Table 4.1-1, Estimated Maximum Daily Construction Emissions. Additionally, the operation of construction equipment would produce combustive emissions of PM_{10} and $PM_{2.5}$ (particulate matter 2.5 microns or less in diameter). However, air quality impacts from construction would be temporary and, pursuant to GBUAPCD policy, fugitive dust emissions from construction activities do not need to be quantified to make a significance determination. Instead, the district maintains that all fugitive dust emissions from construction activities represent a potentially significant, but mitigatable impact (see criteria presented previously). With the implementation of the identified mitigation measures, dust emissions from the Project will not result in any significant impacts.

In addition to the implementation of standard GBUAPCD construction mitigation measures, particulate emissions from construction activities will be minimized by the use of good engineering practices in earthwork, and by the continuous use of water trucks. Compliance with the posted speed limits will be required. Therefore, with implementation of mitigation measures for fugitive emissions, as documented in Section 4.1.3, Mitigation, of this EA, the GBUAPCD requirements would be met and the construction emissions would not contribute significantly to any air quality threshold.

Long-Term Operational Impacts

Except for the first year of operation, long-term operational impacts would not increase the air emissions in the area since no additional activity would be generated. During the first year of operation (up to 12 months), electrical power to operate the downhole pumps, booster pump station, area lighting, and instrumentation would be provided by two 1,500-kilowatt diesel-powered portable generators, each operated at up to 75% of rated capacity for up to 18 hours per day. The generators would be obtained from an equipment rental company, would meet at least Tier 1 state and federal emission standards, and would be registered under CARB's Statewide Portable Equipment Registration Program.[3] The emissions from the two portable generators were estimated using the URBEMIS 2007 program (see previous Equipment Exhaust Emissions section of this EA).

[3] Under the CARB Statewide Portable Equipment Registration Program, portable equipment may operate for up to 12 months at one location without obtaining a permit to operate from the governing air district. If the engine generators were to remain for more than 12 months, they would have to obtain authorization to construct and permits to operate from the GBUAPCD. Accordingly, they would be subject to the GBUAPCD's new source review requirements including the use of best available control technology, such as diesel particulate filters.

The GBUAPCD has not published guidelines for air quality assessments under CEQA; nor does it recommend numerical, mass-emission-based thresholds for operational emissions. Instead, the GBUAPCD recommended that the impact on ambient levels of NO_2 be evaluated to determine whether the emissions would cause an exceedance of the 1-hour and annual CAAQS (D. Ono, pers. comm. 2008).

An ambient air quality impact analysis was conducted for the NO_X emissions from two diesel-powered generators. For this analysis, it was assumed that two "container"-type engine-generator sets would be operated near the western end of the water pipeline. To perform the ambient air quality assessment, stack characteristics were obtained for a Multiquip 40-foot container[4] housing a Cummins-brand 1,500-kilowatt engine-generator set driven by a Cummins KTA50G9 diesel engine.[5] The stack characteristics used in the modeling are as follows:

Stack Height: 13.5 feet
Stack Diameter: 12 inches
Exhaust Flow Rate: 8,950 actual cubic feet per minute
Exhaust Temperature: 865°F
Emission Rates:
Maximum Hour: 18.37 pounds per hour (2.32 grams per second) per engine
Annual Average: 13.78 pounds per hour (1.74 grams per second) per engine
Dimensions of Container (for downwash calculations)
Height: 13.5 feet
Length: 40 feet
Width: 8 feet

All of the NO_X emissions were assumed to be NO_2. This approach is conservative because only about 5% to 10% of the exhaust gas would be NO_2, with the balance being nitric oxide (NO). The NO will convert to NO_2 over time and distance. Thus, this assumption would overstate the potential impact.

The dispersion modeling was performed using the Environmental Protection Agency (EPA)-approved model SCREEN3.[6] The engines were assumed to be located in the center of the northern-most Coso Hay Ranch property in Section 26, Township 21S, Range 37E. The distance to the nearest publicly accessible property line is approximately 4,100 feet (1,250 meters). SCREEN3 was run for potential receptor distances from 4,100 to 32,808 feet (1,250 to 10,000 meters). The point of maximum impact was approximately 3,000 feet (914 meters) from the assumed location of the engines. Because SCREEN3 estimates only 1-hour impacts, the results

[4] http://www.mqpower.com/pages-products/container/EGC1500C.html
[5] http://www.cumminspower.com/www/common/templatehtml/technicaldocument/EmissionDataSheets/na/eds-163.pdf
[6] Lakes Environmental, SCREENView, Version 2.5.0.

from the model run using the annual average emission rate were multiplied by 0.1 to estimate the annual impacts as described in the EPA guidance (EPA 1992). The modeling results were added to the background concentration as shown in Table 4.1-2, Ambient Air Quality Modeling Results. As indicated in Table 4.1-2, the NO_2 concentrations would not cause or contribute to an exceedance of the CAAQS, and the impact would be less than significant.

Table 4.1-2
Ambient Air Quality Modeling Results

Averaging Period	Background Concentration (ppm)	Modeled Impact		Impact plus Background (ppm)	CAAQS (ppm)
		µg/m^3	ppm		
1-Hour	0.055	112.42	0.06	0.12	0.18
Annual	0.005	8.43	0.004	0.009	0.030

Notes: Background concentration are highest values for 2005–2007, Trona monitoring station. NO_X impact modeled for a single engine-generator. The modeled impacts at the point of maximum impact (3,000 feet from the source) were doubled for two units operating concurrently.

The engines would also emit diesel particulate matter, which is designated as a toxic air contaminant and a carcinogen by CARB. However, the engines would operate for up to 1 year only and no off-site receptors are located within 800 meters (2,625 feet) of the Project site. Thus, significant long-term health impacts would not occur.

Therefore, there are no long-term emissions associated with the Proposed Action, and no Project-specific significant impacts to air quality would result from the implementation of the Proposed Action.

4.1.2 Cumulative Impacts

The cumulative effect area for air resources is the Coso Junction PM^{10} Planning Area. There are few sources of emissions in the area. The overwhelming majority of the emissions are transported into the area from Owens Lake in the adjacent air planning area. The GBUAPCD considers most other sources as minor. They identify the control of emissions from Owens Lake as the only necessity to achieve the National Ambient Air Quality for the Coso Junction PM^{10} Planning area. The expected emission levels associated with the proposed Project are not likely to result in or contribute to exceedances of the NAAQS since the emissions will be short term in nature.

4.1.3 Mitigation

The following mitigation measures shall be implemented during construction of the Project to reduce potentially significant impacts associated with fugitive dust (including visibility impacts) to less than significant levels:

- Water all active construction areas, including unpaved access roads (if applicable), at least twice daily or more often if winds exceed 15 miles per hour (mph) or fugitive dust is observed leaving the construction site boundary.

- Enclose, cover, water twice daily, or apply (non-toxic) soil binders to exposed stockpiles (e.g., dirt and sand).

- Limit construction traffic speeds on unpaved roads to 15 mph. All contractors and Project applicant staff who will use unpaved roads during construction of the Project shall be informed of the 15 mph speed limit.

4.2 Soils

4.2.1 Impacts

Implementation of the Proposed Action has the potential to create soil erosion due to removal of vegetation and disruption or compaction of the desert surface. This impact will be reduced to less than significant impacts through implementation of mitigation measures outlined in Section 4.2.3, Mitigation, of this EA.

4.2.2 Cumulative Impacts

The potential cumulative impacts associated with the Proposed Action would also create potential erosion impacts. This may include potential sedimentation and windblown soil. The mitigation measures in Section 4.2.3 that would be implemented for each project would reduce the impacts to less than significant levels. Implementation of the mitigation measures in Section 4.2.3 would reduce these cumulative impacts.

4.2.3 Mitigation

- Application of erosion protection in accordance with the revegetation plan (see Appendix G of this EA) will consist of applying straw over the standard revegetation seed mixture and/or redistributed topsoil, to prevent erosion.

- Construction vehicles will be confined to designated roads and parking areas to prevent compaction of outlying areas.

4.3 Vegetation

4.3.1 Impacts

Implementation of the Proposed Action would result in the loss of desert vegetation, including the creosote–white bursage scrub and allscale scrub communities, as a result of the removal of vegetation during pipeline construction. The construction of the Proposed Action in and near existing roadways and trails will minimize this loss.

Disruption of the soil and the use of equipment from other locations create the potential to further introduce invasive and noxious weeds into the area. This impact is considered potentially significant without mitigation.

As discussed in Section 3.3, Vegetation, of this EA, there is a potential that several special-status plant species may occur along the pipeline alignment. This could constitute a significant impact without mitigation.

4.3.2 Cumulative Impacts

The other cumulative projects have a potential to impact special-status plant species and to introduce invasive and noxious weeds to the area. This would also include impacts to the creosote–white bursage scrub and allscale scrub communities. These impacts can be mitigated through the implementation of the mitigation measures in Section 4.3.3 of this EA.

4.3.3 Mitigation

- COC shall crop or crush, not blade, vegetation underneath and along the pipeline corridor, except in any areas required for above ground supports (see Figure 1, Pipeline and Related Infrastructure), which shall be cleared.

- The pipeline corridor shall be revegetated according to the revegetation plan provided in Appendix G of this EA.

- COC shall gain and maintain access to the pipeline by pruning, not by destruction of existing vegetation through clearing or blading.

- Construction equipment and vehicles shall be cleaned to remove dirt and any vegetative material prior to accessing the site. This will reduce the potential for introduction of invasive or noxious species.

- Prior to construction, monitoring shall occur to determine the presence of noxious or invasive species on or adjacent to the pipeline corridor. Any removal program must be approved by the BLM in advance of its implementation.

- The pipeline corridor shall be monitored for 5 years after completion of construction. Any noxious or invasive species found will be reported to the BLM and control measures will be developed and implemented only after review and approval by the BLM.

- During construction, the pipeline corridor shall be monitored for special-status plant species. Any populations of special-status species shall be identified and avoided through rerouting of the pipeline within the surveyed corridor.

4.4 Surface Water

4.4.1 Impacts

Implementation of the Proposed Action may create short-term erosion impacts associated with pipeline construction. Because the trench surface will be regraded and the soil stabilized, no significant impacts are anticipated. The construction of the Proposed Action will not increase flooding potential within the Project area.

4.4.2 Cumulative Impacts

The cumulative projects may also create similar impacts as the Proposed Action. This will include potential erosion associated with grading for the projects. It is assumed that erosion controls will be implemented for each project and the impacts will be mitigated through this action.

4.4.3 Mitigation

No mitigation measures are required.

4.5 Groundwater

This section is summarized from the Hydrology and Water Quality section of the Inyo County Conditional Use Permit (CUP 2007-003) Draft Environmental Impact Report (DEIR) prepared by MHA/RMT in 2008. Because the Project is considered to involve the transfer of groundwater out of its basin of origin, the Project is subject to the requirements of Chapter 18.77 of the Inyo County Code for review by the Inyo County Water Commission, which makes recommendations to the Inyo County Planning Commission as to the potential hydrologic and environmental impacts of proposed groundwater export projects. The DEIR prepared to support that review sets

forth a comprehensive and detailed review of potential impacts to groundwater resources in Rose Valley from the Project and different operating scenarios, based on hydrologic modeling. The DEIR also includes a detailed Hydrologic Monitoring and Mitigation Plan (HMMP) designed to provide detection of changes in groundwater levels and corresponding requirements for the reduction or curtailment of pumping rates, in response to specified "trigger levels," in time to avoid any significant effects on the groundwater resource and other environmental resources supported by groundwater. The BLM has independently considered the analysis of potential hydrologic and water quality impacts set forth in the Draft EIR (Section 3.2), and the monitoring and mitigation requirements of the HMMP, and has incorporated them by reference in this EA as Appendix H. The following is a very limited summary of those materials; the reader is encouraged to refer to Appendix H of this EA for the corresponding details.

4.5.1 Impacts

This section addresses the groundwater impacts associated with construction of the Proposed Action, impacts to water users in the Rose Valley and Indian Wells Valley, as well as impacts to Little Lake and Coso Hot Springs.

Groundwater Impacts Associated with Pipeline Construction

Implementation of the Proposed Action would include the construction of down-hole pumps, new well heads, storage tanks, and a pipeline. It is estimated that this would require 4,500 gallons per day during the construction period. This is expected to result in only a minimal change in groundwater levels and will not create a significant impact.

Impact to Rose Valley Water Users

Operation of the Proposed Action would result in drawdown of the water table in Rose Valley. Based on hydrologic modeling, the groundwater is predicted to decline from 25 to 55 feet for the wells in Dunmovin, approximately 1.5 miles north, from 20 to 50 feet at Coso Junction, from 7 to 20 feet at Cinder Road/Red Hill West, and from 4 to 11 feet for Little Lake Ranch North. These declines would occur in the 30-year timeframe with the decline increasing over time to that level. This predicted lowering of the groundwater table in the vicinity of groundwater users, which would potentially inhibit access to groundwater, is considered significant. Due to the predicted low level of drawdown in the southern portion of the valley, water supply wells in this location may not need any equipment changes. For wells in the Dunmovin area and in Coso Junction, existing wells may be impacted through the decline in water levels, making the current well equipment unable to produce the volume of water currently produced. This impact will be mitigated by the applicant monitoring the wells in accordance with the HMMP and modifying the wells or equipment as necessary to allow these wells to function at current levels, at the Project Proponent's expense.

Impact to Water Users in the Indian Wells Valley

Groundwater modeling indicates that impact to the Indian Wells Valley water users would be less than significant with the reduction in flows less than 3% of total recharge estimated.

Impact to Little Lake

The potential impacts to Little Lake water levels predicted by the groundwater modeling are considered significant. The springs that feed the lake may be dependent upon groundwater levels. Groundwater modeling has indicted that there will be a reduction in groundwater levels and reduction in spring flows at Little Lake. The monitoring and mitigation measures in the HMPP are designed to avoid these potential significant impacts. The trigger levels for the reduction or cessation of pumping to protect the groundwater levels and any dependent environmental resources at Little Lake have been conservatively set. The Project Proponent will bear the risk that it will be unable to pump as much groundwater as planned for the Project.

Impact to Coso Hot Springs

No adverse impact to Coso Hot Springs is expected. The extensive monitoring of these springs during the 20+ years of geothermal resource development and utilization in the Coso KGRA has not demonstrated a direct connection between the springs and the geothermal reservoir. BLM has entered into a Programmatic Agreement with the SHPO and the ACHP (Appendix D) to provide a continuing framework for monitoring and addressing potential impacts to Coso Hot Springs from the Proposed Action.

4.5.2 Cumulative Impacts

The potential impacts to groundwater resources in Rose Valley from the Proposed Action may be increased by the Crystal Geysers project and LADWP Haiwee Reservoir seepage recovery project, if either or both of those projects proceed. The HMMP addresses this possibility.

4.5.3 Mitigation

The following mitigation measures are expected to reduce potentially significant impacts to less than significant levels:

- The Project Proponent shall implement the HMMP (see Appendix H) as approved by Inyo County.

4.6 Wildlife

4.6.1 Impacts

Implementation of the Proposed Action has the potential to impact wildlife species in general and special-status species in particular. In general, the potential impact will be short term in nature during the construction period. Once the pipeline is in place and the site is revegetated, the remaining potential impacts to wildlife habitat would be minimal.

The proposed Project is located in an area that is considered the north-westernmost limit of the range of the desert tortoise. Rose Valley is potential habitat for the desert tortoise. Surveys for the tortoises along the pipeline alignment by UltraSystems in March of 2005 (Appendix I of this EA) and by EREMICO Biological Sciences in August of 2007 for the Gill Station Road Improvement and then in April 2008 for the DEIR, did not identify any tortoises on the proposed alignment. Burrows and other signs were noted. Therefore, at most, the area could contain low densities of tortoises. Based on these findings, impacts to this species are not anticipated. BLM has initiated formal consultation with the USFWS on effects to the desert tortoise. The avoidance requirements included in the mitigation measures are intended to avoid the need for incidental taking authorization with respect to the desert tortoise.

The Project area is within the range of the Mohave ground squirrel. Surveys in the area including the proposed pipeline alignment did not result in observation of ground squirrels. Because they are difficult to observe, there is a potential that the species could occur in the area. Mitigation measures for the species are provided in Section 4.6.3, Mitigation, of this EA. In support of the approval by the CEC of Small Power Plant Exemption for the Coso Navy 2 Geothermal Project, in 1988, BLM, CLNAWS, and CDFG entered into a Stipulation for Mitigation of Impacts to the Mohave Ground Squirrel at the Coso Known Geothermal Resource Area (Stipulation and Mitigation Plan, included as Appendix C of this EA), an Approved Mohave Ground Squirrel Mitigation Plan. The Stipulation and Mitigation Plan required the establishment of a 43,448.5-acre Coso Grazing Exclosure Mitigation Program, which includes Mohave ground squirrel trapping within the exclosure and evaluations every 5 years for the life of the Project. The Stipulation and Mitigation Plan allows surface land disturbance within the Coso KGRA of up to 2,193 acres on the federal lands covered by the plan. To date, only 474.69 acres of this allowance has been used. The surface disturbance calculations are reported annually to the CEC.

The CDFG recognizes that the 1988 Stipulation and Mitigation Plan is “grandfathered in” under the provisions of Cal. Fish and Game Code Section 2081, and therefore, that no additional incidental taking authorization or habitat compensation will be required with respect to the potential impacts on the Mohave ground squirrel resulting from the Hay Ranch Project on the federal lands covered by the Stipulation and Mitigation Plan. COC has submitted an application to CDFG for a 2081 Incidental Take Permit with respect to the Mohave ground squirrel in relation to Project activities to be conducted on private land.

4.6.2 Cumulative Impacts

It is unlikely that the other projects would impact desert tortoise due to the low densities of the species in the area. Other activities and developments in the Project area that have the potential to compound the impacts of the Proposed Action on wildlife in general, and the Mohave ground squirrel in particular, include the Deep Rose Project and existing pumice mine. Although the amount of acreage leased for geothermal and mining uses are reasonably known, the amount of existing disturbance to soils and specific wildlife habitat types has not yet been identified for these projects. However, the Proposed Action's incremental effect on the Mohave ground squirrel would not be cumulatively significant. The mitigation measures in Section 4.6.3 of this EA would also apply to those projects.

4.6.3 Mitigation

The following mitigation measures are proposed:

- The pipeline corridor shall be revegetated according to the revegetation plan for the proposed Project (Appendix G).

- Preconstruction biological monitoring shall be conducted prior to construction to identify any possible tortoises or ground nesting birds within the pipeline alignment. Any potential tortoise, Mohave ground squirrel burrows or ground nesting sites in the alignment shall be examined prior to construction to assure their avoidance.

- A tortoise-proof exclusion fence shall be installed around the proposed Project construction area including staging areas and laydown sites; the fencing shall be maintained throughout construction and all work shall be conducted within the fenced areas.

- A qualified biological monitor shall be on site during all phases of construction. The biological monitor shall ensure that the tortoise fencing remains in place and that all work occurs in place within the fenced areas.

- All construction workers shall be briefed as to measures to avoid impacts to desert tortoise and other special-status species; these measures shall include proper disposal of solid waste, no driving in areas outside of the tortoise enclosures, and the exclusion of pets and firearms from the Project site.

- The Project Proponent shall debit 48.42 acres from its remaining acreage credit allowance under the approved Mohave Ground Squirrel Mitigation Plan.

- The Project Proponent shall obtain an incidental taking permit with respect to the Mohave ground squirrel to authorize incidental takings that may occur on private land in connection with the Project, and shall satisfy all habitat compensation requirements of the CDFG as a condition of that authorization.

4.7 Cultural Resources

4.7.1 Impacts

Existing archaeological sites registered in the NRHP were found within the Project APE. However, impacts to these sites due to the Proposed Action can be minimized through adoption of mitigation measures outlined in Section 4.7.3 of this EA. No residual impacts to cultural resources are anticipated after the implementation of the mitigation measures described here.

4.7.2 Cumulative Impacts

The other projects in the cumulative baseline may impact cultural resources. Each of these projects would be required to follow similar mitigation measures as described in Section 4.7.3 of this EA.

4.7.3 Mitigation

All sites found in the Project APE will be avoided during construction by shifting that portion of the APE for the proposed pipeline to within the paved or gravel roadway (Gill Station Road). This avoidance includes a 30-meter (98-foot) buffer zone around large sites (INY-1863, INY-2125, INY-4413, and CGP-2), and a 10-meter (33-foot) buffer zone around small ones (INY-3406 and CGP-1). A cultural monitor is required during any construction activities within any avoidance area, along with the temporary placement of orange environmental fencing to protect the sites.

4.8 Native American Values

4.8.1 Impacts

Impacts to Native American resources from the Proposed Action are addressed through the Programmatic Agreement (PA) (Appendix D of this EA) signed with the BLM, SHPO, and ACHP. With mitigation, no significant impact regarding Native American values would result from implementation of the Project.

4.8.2 Cumulative Impacts

No cumulative impacts to Native American values are anticipated. Each of the projects in the cumulative baseline will be mitigated as described in Section 4.8.3, Mitigation, of this EA.

4.8.3 Mitigation

As a result of consultation among the five tribes of the Owens Valley region (Bishop, Big Pine, Fort Independence, Lone Pine, and Timbisha Shoshone of Death Valley), BLM has included the Coso Hot Springs within the APE for this Project. Further consultation between these tribes and BLM led to the completion of a Programmatic Agreement (PA) that will allow BLM to take into account the effects of the undertaking on both Coso Hot Springs and the archaeological sites within the proposed pipeline corridor. This PA was signed by BLM, SHPO, and the ACHP in Washington, D.C. during the summer of 2008 (included as Appendix D of this EA).

The major provisions of the PA require that BLM will assume all archaeological sites within the APE as eligible for the NRHP.

- BLM will ensure that the pipeline route and construction avoids the six archaeological sites located within the APE.
- A qualified archeologist and Native American monitor will be present during construction activities.
- CLNAWS has been monitoring the geophysical state of the Coso Hot Springs on a monthly basis since 1979 as a provision of an earlier PA related to the construction of the initial geothermal facility, and an annual report that tallies these monthly observations will be distributed to the signatory and concurring parties to the PA.
- CLNAWS has been coordinating the visitation and use of Coso Hot Springs by Native Americans and Traditional Practitioners since 1979 (Appendix A) as a provision of an MOU between the Coso Ad Hoc Committee, composed of acknowledged individuals from the Owens Valley tribes and Kern County Indian Community, and an annual summary of Native American use of the Coso Hot Springs will be provided to the signatories and concurring parties to the PA.
- If changes in use patterns by the Traditional Practitioners resulting from the implementation of the undertaking are identified, BLM and CLNAWS will initiate consultation among the signatory and concurring parties regarding the observed changes.

In order to minimize impacts to Native Americans traveling to the Coso Hot Springs, vehicle traffic (within a reasonable distance of the religious activity) will be halted or kept to a minimum

during ceremonial and religious observances related to the visitation. CLNAWS will notify the Project Proponent of Native American visits to the designated prayer sites and Coso Hot Springs so that activities such as construction can be scheduled to minimize or eliminate interference with these ceremonial activities.

4.9 Visual Resources

4.9.1 Impacts

Scenic Quality: The water delivery Project can be divided into two parts: the portion on the western end of the alignment, from the North Well to the South Well and proposed pump station, to Gill Station Road; and the portion that is adjacent to the existing roadway.

The portion on the western end of the alignment is most visible to the general public, as the South Well is located approximately 2,000 feet east of U.S. Highway 395. However, the view to the east of U.S. Highway 395 has a scenic quality of Class C, as the North and South Wells are existing facilities. According to the BLM VRM guidelines, Class C is described as fairly common to the physiographic region. The SCE 115 kV transmission line is located behind the wells, with the Gorge Rinaldi 500 kV SCE/DWP transmission line in the foreground. The water pipeline between the North Well and the South Well is proposed to be underground. The proposed pump station will be located behind the South Well and will include a 250,000-gallon collection tank that will be protected with a perimeter fence.

The water pipeline, adjacent to the roadway, is proposed to be underground for almost the entire length up to the injection system near the Coso geothermal area. There is a small section of pipeline that will be aboveground (approximately 500 feet in length). This is located just outside of the CLNAWS boundary. The other aboveground structure will be the holding tank (at the High Point Tank Site), located inside the CLNAWS boundary. Due to the presence of the roadway, this portion of the Project also has a scenic quality of Class C (see Figure 1, Pipeline and Related Infrastructure)

Sensitivity Level: Because of the presence of the water wells and electrical transmission lines along the western end of the alignment, and an existing roadway along the remainder of the alignment (to the water line route), the sensitivity level for changes in the scenic quality is low. The water line will be buried underground for a large majority of the length and this would minimize the likelihood of adverse impacts to scenic quality.

Distance Zones: The distance zone of the western end of the alignment would be located in the foreground/middleground of the landscape, with the underground water pipeline and proposed pump station located in the vicinity of U.S. Highway 395. The proposed water pipeline route adjacent to the roadway would be in the background, or in seldom-seen areas, as the roadway

proceeds through an unpopulated area. The roadway provides access to an active mining operation and the Coso KGRA; these are not areas of high interest to tourists.

There are no impacts to visual resources due to the Proposed Action. The structures in the Proposed Action are only located within Hay Ranch, the facilities will be buried and construction will occur in or near existing disturbed areas such as roads.

4.9.2 Cumulative Impacts

Each of the projects in the cumulative impact baseline has the potential to create visual impacts. None of these impacts are expected to be significant in that they are not impacting scenic areas.

4.9.3 Mitigation

Since no impacts to visual resources are expected as a result of the Proposed Action, no mitigation measures are required.

4.10 Outdoor Recreation and Open Space

4.10.1 Impacts

The Proposed Action will not adversely impact any National Scenic Trails or National Historic Trails. After construction of the Proposed Action, it is expected that the area will appear much as it does presently. The water pipeline is proposed to be installed underground for all but small portions at the locations shown on Figure 1, Pipeline and Infrastructure. The water pipeline will predominantly be located adjacent to an existing road.

4.10.2 Cumulative Impacts

None of the projects considered in the cumulative baseline are anticipated to produce significant environmental impacts to recreation. This is because the projects are not occurring in areas used for high levels of recreation.

4.10.3 Mitigation

No mitigation measures are required.

4.11 Social and Economic Values

4.11.1 Impacts

There would be no impact on the two major economic sectors (Tourism and Resource Extraction) of the regional economy due to the Proposed Action. No significant impacts regarding social and economic values would result from implementation of the Project.

4.11.2 Cumulative Impacts

It is anticipated that the Proposed Action combined with the other cumulative projects in the baseline will increase the economic activity in the region, resulting in a beneficial cumulative impact.

4.11.3 Mitigation

Since the Proposed Action would have no significant impact on social and economic values, no mitigation measures are required.

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REFERENCES CITED

BLM (U.S. Department of the Interior Bureau of Land Management). 1980a. Proposed Leasing with the Coso Known Geothermal Resource Area (KGRA): Final Environmental Impact Statement.

BLM. 1980b. *California Desert Conservation Area Plan Environmental Impact Statement (EIS).* Desert District, Riverside, California.

BLM. 1988. *National Environmental Policy Act Handbook, H-1790-1*, particularly Chapter IV, "Preparing Environmental Assessments." October.

BLM. 1999. *West Mojave Plan, Evaluation Report.* September.

BLM. 2003. *Environmental Impact Report and Statement for the West Mojave Plan, a Habitat Conservation Plan and California Desert Conservation Area Plan Amendment*. Vols. I and II.

BLM, CLNAWS (China Lake Naval Air Weapons Station), CDFG (California Department of Fish). 1988. *Stipulation for the Impacts of the Mohave Ground Squirrel at the Coso Known Geothermal Resource Area (KGRA) and Mitigation Plan*.

BLM**,** SHPO (State Historic Preservation Officer), AHCP (Advisory Council on Historical Preservation). 2008. *Programmatic Agreement Regarding the Hay Ranch Project*.

CalFlora. 2000. Information on California plants for education, research, and conservation. [web application]. Berkeley, California: The CalFlora Database [a non-profit organization]. Available: http://www.calflora.org.

California Air Resource Board. 2008. Air quality data at Project Area.

Caltrans (California Department of Transportation). 1999. *Inyo-Tulare Counties, California Road System, Map 14Q*.

CDFG (California Department of Fish and Game). 2003a. "List of California Terrestrial Natural Communities Recognized by the California Natural Diversity Database." *California Natural Diversity Database*. CDFG Habitat Data Analysis Branch, Vegetation Classification and Mapping Program. September 2003.

CDFG. 2003b. California Natural Diversity Database. Special Plants. Unpublished report available from CDFG, Natural Heritage Division, Sacramento, California. January.

CDFG. 2003c. California Natural Diversity Database. Special Animals. Unpublished report available from CDFG, Natural Heritage Division, Sacramento.

CDFG. 2004. *Rarefind*. Version 2. *California Natural Diversity Database (CNDDB)*. A database application. Sacramento, California: California Department of Fish and Game. February 5.

CNPS (California Native Plant Society). 2001. *Inventory of Rare and Endangered Vascular Plants of California.* Electronic records of sensitive species on the USGS 7.5' Condor Peak Quadrangle. Rare Plant Scientific Advisory Committee, D.P. Tibor, Convening ed. Sacramento, California.

Coso Operating Company LLC, March 2005. *Biological Assessment Hay Ranch Water Extraction and Delivery System.* Prepared by UltraSystems.

Coso Operating Company LLC, March 2005. *Cultural Resources Inventory for the Hay Ranch Water Extraction and Delivery System, Coso Geothermal Project, Inyo County, California*. Prepared by ASM Affiliates, Inc.

Coso Operating Company LLC, April 2004. *Contract Drawings for the Construction of the Hay Ranch Water Extraction and Delivery System at Coso Geothermal Project, Inyo County, California*. Prepared by Veizades & Associates, Inc.

Coso Operating Company LLC, April 2004. *Plan of Development for Hay Ranch Water Extraction and Delivery System at Coso Geothermal Project, Inyo County, California*.

Coso Operating Company LLC, November 2003. *Revised Report on the Feasibility Study and Potential Permitting and Engineering of the Injection Augmentation Project Coso Operating Company LLC*. Prepared by GeoTrans, Inc.

EPA (U.S. Environmental Protection Agency). 1992. Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised (EPA-454/R-92-019). October.

Inyo County. 2001. *General Plan*, particularly Section 2, "Guide to Inyo County Communities," Section 4, "Land Use Element," and Section 5, "Economic Development Element." December.

Kleinfelder. 2007. *A Preliminary Jurisdictional Wetland–Proposed Water Pipeline Installation-Inyo County, California.* December.

Leitner, Philip. 2007. *Biologist, Endangered Species Recovery Program, California State University, Stanislaus.*

MHA Environmental Consultants (MHA). 2008. *Draft Environmental Impact Report: Coso Operating Company Hay Ranch Water Extraction and Delivery System.* July.

NWC (Naval Weapons Center). 1979. *Final Environmental Impact Statement for the Navy Coso Geothermal Development Program, China Lake, California*. Volumes 1 and 2.

Sawyer Keeler-Wolf. 1995. *A Manual of California Vegetation. Sacramento, California: CNPS.*

PERSONAL COMMUNICATION

Duane Ono. 2008. Deputy Air Pollution Control Officer, Great Basin Unified Air Pollution Control District, personal communication with David Deckman, Dudek, September 9.

Glenn Harris. 2008. Natural Resources Specialist, Bureau of Land Management, personal communication with Colleen Brock, Coso Operating Company, October

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DECISION RECORD FINDINGS OF NO SIGNIFICANT IMPACT – FONSI (40 CFR 1508.13)
Finding of No Significant Impact
Coso Geothermal Project
Hay Ranch Water Extraction & Delivery System, Right-of-Way Application CACA-046298
NEPA Compliance Document Number CA-650-2005-100

INTRODUCTION:

The Bureau of Land Management (BLM) prepared an environmental assessment (EA), in accordance with the National Environmental Policy Act of 1969, 42 U.S.C. §§ 4321-4347 (NEPA), the regulations of the Council on Environmental Quality, 40 C.F.R. Part 1500, and the BLM NEPA Handbook (H-1790-1), to analyze the environmental impacts of a granting an application for a right-of-way across Public Land for the purposes of the Hay Ranch Water Extraction & Delivery System (Proposed Action). The Proposed Action and considered alternatives would take place within the California Desert Conservation Area (CDCA). The CDCA Plan, originally approved in 1980 and last amended in 2006 by the West Mojave Plan, is the land use plan that governs public land management in the California Desert.

BACKGROUND AND PROPOSED ACTION:

The BLM has prepared the attached EA (CA-650-2005-100) addressing the application by Coso Operating Company LLC (Coso) for a right-of-way across Public Land (Application Case File No. CACA-046298) to develop the Hay Ranch Water Extraction & Delivery System (Hay Ranch Project). The EA analyzed the impacts of the Proposed Action and alternatives to supply supplemental injection waters from the Hay Ranch water well to the Coso geothermal reservoir. This project would entail construction of a groundwater extraction and pipeline delivery system from the Hay Ranch to the water distribution station and an existing injection system located at the Coso Geothermal Field on withdrawn land managed by the Navy as part of the China Lake Naval Air Weapons Station (CLNAWS).

The project site affects private land, Navy withdrawn land and Public Land managed by the BLM within Inyo County, California. The proposed pipeline and tanks includes an approximately 9 miles long by a 50 feet wide right-of-way encompassing a total area of approximately 55 acres. The pipeline primarily follows an existing roadway. Most of the pipeline will be buried except where geologic features force the pipeline above ground.

PRIVATE LAND: 5.63 acres of the Proposed Action will affect Coso's private land (Hay Ranch) located within Sections 25 & 26, T. 21 S., R. 37 E., MDBM. The Hay Ranch has two existing water wells (North and South wells), which will be the source of water for the project. A 12-inch pipeline will be installed at the North well and will transport water to the South well area to a 250,000-gallon collection tank. The collection tank will provide the suction supply to a new booster pump station consisting of two vertical turbine pumps. These pumps will discharge through a surge tank, and connect to the main pipeline. The South well will be tied into the 20-inch pipeline that will cross BLM-managed public land and terminate on Navy-managed withdrawn land.

PUBLIC LAND: The 20-inch water pipeline crossing the BLM managed public land will encompass 32.24 acres located within Sections 35 and 36, T. 21 S., R. 37 E., and Sections 31 through 34, T. 21 S., R. 38 E., MDBM.

WITHDRAWN LANDS: The pipeline continues onto Navy withdrawn land where a 1.5 million gallon holding tank (100 ft diameter by 28 ft high) identified as the High Point Tank will be constructed to hold the water. The pipeline will continue from the tank to the existing 88-1 injection well. Together the pipeline and

tank encompass 16.88 acres (16.18 acres for the pipeline and 0.7 acres for the High Point Tank) located within Sections 1 through 3, T. 22 S., R. 38 E., MDBM.

The BLM is the lead agency under NEPA with respect to the Proposed Action. The Navy is a cooperating agency under NEPA, and is acting on Coso's request for an easement for the portion of the pipeline and the High Point Tank to be located within the CLNAWS.

Coso has applied to Inyo County for a conditional use permit to authorize the development of the ground water supply and the construction and operation of the Hay Ranch Project components proposed to be located on private land. Inyo County is the lead agency reviewing the Hay Ranch Project under the California Environmental Quality Act (CEQA), and has prepared and circulated for public comment a draft Environmental Impact Report (Draft EIR) addressing the Hay Ranch Project. The Draft EIR indicates that, with identified mitigation, there will not be any significant environmental impacts as a result of the Hay Ranch Project. The BLM considered the Draft EIR along with its review of the Proposed Action under NEPA, and incorporated by reference the Draft EIR into the EA. To eliminate potential significant impacts the BLM is including as conditions of its approval of the Proposed Action certain mitigation requirements identified in the Draft EIR.

DISCUSSION

The EA evaluates the potential environmental effects of the Proposed Action and alternatives, focusing on the following issue areas: geology; air quality; soils; vegetation; hydrology; wildlife habitat; cultural resources; visual resources; outdoor recreation and open space; and socio and economic value. BLM's evaluation of impacts and mitigation measures has been guided by the public comments on BLM's previous environmental assessment of the Proposed Action (issued for public comment on May 30, 2006), as well as the analysis set forth in the subsequent Draft EIR. BLM's evaluation is summarized below.

Air Quality

The project area is located in Inyo County within the Great Basin Valleys Air Basin and is under the regulatory jurisdiction of the Great Basin Unified Air Pollution Control District (GBUAPCD).

Emissions from the Proposed Action will come from both direct and indirect sources. Direct emissions in the form of PM_{10} will come from vehicle use on the access roads, heavy equipment operation, and material handling and drilling. Portable generators may power the pumps for up to a year after approval of the Proposed Action. Modeling of these impacts indicates that emissions will be less than significant.

Mitigation measures shall be implemented during construction of the project to reduce impacts associated with fugitive dust (including visibility impacts) to less than significant levels.

Soils

Implementation of the Proposed Action has the potential to create soil erosion due to removal of vegetation and disruption or compaction of the desert surface. With mitigation, impacts will be reduced to less than significant levels.

Vegetation

Implementation of the Proposed Action will result in the loss of desert vegetation, including Creosote White Bursage Scrub and Allscale Scrub habitat, through removal of vegetation during pipeline construction. The

construction of the pipeline adjacent to the existing roadways and trails will substantially reduce this loss. Disruption of the soil and the use of equipment from other locations create the potential to further introduce invasive and noxious weeds into the area. With mitigation, this impact will be less than significant.

Hydrology

Groundwater Impacts Associated with Pipeline Construction

Implementation of the Proposed Action will include the construction of down-hole pumps, new well heads, storage tanks and a pipeline. It is estimated that this will require no more than 45,000 gallons of water per day during the construction period. This is expected to result in only a minimal change in groundwater levels and will not result in any significant impact.

Impact to Rose Valley Water Users

Operation of the Proposed Action would result in drawdown of the water table in Rose Valley. Based on hydrologic modeling, the groundwater level is predicted to decline from 25 to 55 feet for the wells at Dunmovin, approximately 1.5 miles north of Hay Ranch, from 20 to 50 feet at Coso Junction, from 7 to 20 feet at Cinder Road/Red Hill West, and from 4 to 11 feet at the Little Lake Ranch North Well. These declines have been modeled to occur in a 30-year timeframe with the decline increasing over time to the projected levels. This predicted lowering of the groundwater table in the vicinity of groundwater users, which would potentially inhibit access to groundwater, is considered significant. Due to the predicted minor level of drawdown in the southern portion of the valley, water supply wells in this location may not need any equipment changes. For wells in the Dunmovin area and in Coso Junction, existing wells may be impacted through the decline in water levels, making the current well equipment unable to produce the volumes of water currently produced. This impact will be mitigated by Coso monitoring of the wells in accordance with the Hydrologic Monitoring and Mitigation Plan (HMMP) and it's modifying the wells or equipment as necessary to allow these wells to function at current levels, at Coso's expense.

Impact to Water Users in the Indian Wells Valley

Groundwater modeling indicates that impact to the Indian Wells Valley water users would be less than significant with the modeled reduction in flows being less than 3% of total recharge.

Impact to Little Lake

The potential predicted groundwater modeling impacts to Little Lake water levels without mitigation are considered significant. The springs that feed the lake may be dependent upon groundwater levels. The County has proposed monitoring and mitigation measures in the HMPP that are designed to avoid these potential significant impacts. The trigger levels for the reduction or cessation of pumping to protect the groundwater levels and any dependent environmental resources at Little Lake are very conservatively set in the HMPP. Coso will bear the risk that it will be unable to pump as much groundwater as planned for the Hay Ranch Project.

Impact to Coso Hot Springs

No adverse impact to Coso Hot Springs is expected. The extensive monitoring of these springs during the 20+ years of geothermal resource development and utilization in the Coso Known Geothermal Resource Area (KGRA) has not demonstrated a direct connection between the springs and the geothermal reservoir. On July 8, 2008 the BLM has entered into a Programmatic Agreement (Appendix D of the EA) with the California State Historic Preservation Officer and the Advisory Council on Historic Preservation to provide a continuing framework for monitoring and addressing potential impacts to Coso Hot Springs from the Proposed Action.

Wildlife Habitat

Implementation of the Proposed Action potentially could affect desert tortoise and the Mohave ground squirrel due to construction activities. The proposed construction will also have the potential to impact ground nesting birds, most notably the burrowing owl and horned lark. Other activities and developments in the Coso KGRA that have the potential to compound the impacts of the Proposed Action on wildlife in general, and the Mohave ground squirrel in particular, include the Deep Rose Project and the existing Kimcrete and Makayla pumice mine operations. The potential habitat impacts of the Proposed Action will mostly be limited to the construction period. Potential impacts to species during that period will be reduced to insignificant levels by implementing certain avoidance measures. Once the pipeline is in place and the site is revegetated, the potential operations impacts to wildlife habitat will be minimal. BLM has consulted with the U.S. Fish and Wildlife Service with respect to the potential impacts on the desert tortoise and its habitat, in accordance with Section 7 of the federal Endangered Species Act, 16 U.S.C. § 1536(a)(2).

Cultural Resources (Native American Values)

Impacts to Native American resources from the Proposed Action are addressed through a Programmatic Agreement (PA) signed July 8, 2008 with the Bureau of Land Management, State Historic Preservation Officer, and Advisory Council on Historic Preservation.

Visual Resources

There will be no significant impacts to visual resources as a result of the Proposed Action. The limited above-ground structures that will be constructed will not be readily visible to the public.

Outdoor Recreation and Open Space

The Proposed Action will not adversely impact any National Scenic Trails or National Historic Trails. After construction of the Proposed Action, it is expected that the area will appear much as it does presently. The water pipeline is proposed to be installed underground for all but a small portion. The water pipeline will predominantly be located adjacent to an existing road. The Proposed Action will have no impact on outdoor recreation and open space, and therefore no mitigation measures will be required.

Social and Economic Values

There will be no impact on the two major economic sectors (Tourism and Resource Extraction) of the regional economy due to the Proposed Action.

ALTERNATIVES CONSIDERED

Alternatives considered to accomplish the purpose of the Proposed Action for this Project were identified and considered by the BLM. In accordance with Title 40 CFR 1502.14 (a), the identification of reasonable alternatives is limited by physical and land use/environmental factors. Physical factors include the geothermal well sites, the water pipeline and tanks, and access roads to the well field. Land use/environmental factors are those that limit such activities in undisturbed areas because of either specific land use designations and restrictions (e.g., multiple-use class designation, critical habitat/wilderness), or additional new negative significant environmental impacts that could occur when compared to using existing disturbed corridors/routes. Also considered was whether the alternative meets the purpose, need, and objectives of the

Proposed Action; whether the alternative conflicts with a specific provision of the applicable land use plan (CDCA Plan, as amended); whether the alternative directly conflicts with federal, state, and local laws and regulations; and whether the alternative is technically and economically feasible.

The Draft EIR identifies and analyzes a reasonable range of alternatives:

- Increasing power generation output through power plant enhancements;
- Alternative sources of injection waters, including groundwater wells on CLNAWS, groundwater wells in the Coso Basin, and marginal geothermal wells in the Coso Range;
- Reducing the duration of the proposed pumping;
- Pumping Hay Ranch wells at maximum rate sustainable for the 30-year project life without reaching trigger levels; and
- Pumping Hay Ranch wells at lower rates.

The BLM independently considered the analysis of these alternatives presented in the Draft EIR and incorporated that analysis by reference into the EA. Ultimately, the BLM has concluded that none of these alternatives is preferable to the proposed Project, considering the purpose and objectives of the Project and the comparative potential environmental effects of the Project and the alternatives.

RATIONALE

The Proposed Action, with implementation of the identified mitigation measures, will not result in significant adverse impacts on geology, soils, hydrology, water quality, air quality, biological resources, land use, recreation, or any other critical elements of the human environment. Approval of the Proposed Action will provide a public benefit by allowing the Hay Ranch Project to increase its electrical generation capacity derived from clean and renewable energy sources.

BLM, in its capacity as NEPA lead agency responsible for management of public lands, has determined that the Proposed Action can be approved in accordance with relevant federal laws, regulations, and policies. Specific to geothermal power, the Proposed Action implements an important strategy in the President's National Energy Policy; that is, to encourage the development of renewable energy resources. Accordingly, BLM's Interim Geothermal Energy Development Policy (IM2003-020) stipulates that rights-of-way should be managed to encourage the development of geothermal energy in acceptable areas while minimizing impacts to natural, cultural, and visual resources on the public lands.

PUBLIC INVOLVEMENT

The proposal was first listed on the Ridgecrest Field Office's NEPA/Project Tracking Page FY-2005 and Number Assignment on August 2, 2005. As part of the public involvement process, the Proposed Action was discussed with the BLM's Steering Committee and the BLM held an open house discussion on May 30, 2006 to solicit public comment on the Proposed Action.

The Hay Ranch Water Extraction and Delivery System Environmental Assessment (Original EA) was published for a 30-day public comment period on May 30 2006 ending on June 15, 2006, with an extension to July 28, 2006. The original EA has been revised to reflect the public comments received.

FINDING OF NO SIGNIFICANT IMPACT

The BLM's interdisciplinary review and analysis has determined that the Proposed Action will not result in any significant impacts to the environment based on criteria established by regulations, policy and analysis.

I have reviewed the above-mentioned revised NEPA compliance document, CA-650-2005-100, and have determined that the Proposed Action is in conformance with the CDCA Plan.

I have further determined, based on the analysis in CA-650-2005-100, that this is not an action that will significantly affect the quality of the human environment; therefore, an Environmental Impact Statement is not required. My determination is based on the rationale that significance criteria, as defined by the Council on Environmental Quality (Title 40 CFR 1508.27) are not being met, or if met will be mitigated to a level that will not be significant. Title 40 CFR 1500.5 (l) Using a finding of no significant impact when an action not otherwise excluded will not have a significant effect on the human environment (Title 40 CFR 1508.13) and is therefore exempt from requirements to prepare an Environmental Impact Statement.

The following rationale was used to determine that significant impacts were not present for each criteria mentioned in Title 40 CFR 1508.27:

Rationale for Less than Significant Impact Determination

1. Beneficial and adverse impacts.

Beneficial and adverse impacts associated with the Proposed Action are clearly disclosed in the EA.

2. The degree to which the Proposed Action and alternatives affect public health or safety.

Significant effects to public health and safety are not anticipated to result from implementation of the Proposed Action.

3. Unique characteristics of the geographic area.

While the Proposed Action is in close proximity to resources considered to be unique (i.e., cultural/heritage resources), this in and of itself does not require the preparation of an Environmental Impact Statement. The critical factor here is whether the Proposed Action would have a significant adverse impact on these unique resources. Based on the analysis present in the EA, I do not believe that Proposed Action significantly affects the characteristics of the unique resources; in addition, the impacts from implementation of the Proposed Action are local rather than national or regional in nature.

4. The degree to which the effects on the human environment are likely to be highly controversial.

The nature of potential effects on the human environment from the Proposed Action is well established and not likely to be highly controversial. While the public may perceive the issue to be controversial, there is no substantial scientific controversy over the impacts of the decision.

5. The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.

The effects on the human environment from the Proposed Action that uncertain (to the extent of ground water drawdown and effects on the Coso Hot Springs) have been fully addressed through mitigation measures and do not involve unique or unknown risks.

6. The degree to which the action or alternatives may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.

The Proposed Action is consistent with adjacent uses for the project area and will not establish a precedent for the future nor does it represent a decision in principle about a future consideration.

7. Whether the action is related to other actions with individually insignificant but cumulatively significant impacts.

The Proposed Action is not related to other past, present or reasonably foreseeable actions likely to result in any significant impacts. Cumulative impacts relative to the issues are discussed in Section 4 of the EA.

8. The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places, or may cause loss or destruction of significant scientific, cultural, or historical resources.

The ground disturbing activities associated with the Proposed Action will not directly adversely affect any sites eligible for the National Register of Historic Places. Potential indirect effects to sites eligible for the National Register are addressed in the EA.

9. The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973.

The biological evaluation prepared for this EA determined that the project will not adversely affect any sensitive, threatened, endangered or proposed for listing species. The U.S. Fish and Wildlife Service is completing a Biological Opinion in support of the Proposed Action.

10. Whether the action threatens a violation of Federal, State, or local law or other requirements imposed for the protection of the environment.

The action will not violate Federal, State, and local laws or requirements for the protection of the environment. Applicable laws, regulations and policies are considered in the EA. The Proposed Action does not set a precedent for other projects that may be implemented to meet the goals and objectives of the CDCA Plan.

Based on these factors, the BLM does not believe significant impacts will occur and therefore, an EIS is not required.

The Proposed Action if implemented with the environmental protection measures identified in CACA-046289, and EA CA-650-2005-100 will not result in a significant impact to the environment.

_____ _____

Hector A. Villalobos Date
Field Manager

MITIGATION MEASURES

The following mitigation measures are expected to reduce potentially significant impacts in the following areas to less than significant levels: air quality; soils; vegetation; groundwater; wildlife; cultural resources; and Native American values.

Air Quality

- Water all active construction areas, including unpaved access roads (if applicable), at least twice daily or more often if winds exceed 15 miles per hour (mph) or fugitive dust is observed leaving the construction site boundary.
- Enclose, cover, water twice daily, or apply (non-toxic) soil binders to exposed stockpiles (e.g., dirt and sand).
- Limit construction traffic speeds on unpaved roads to 15 mph. All contractors and Project applicant staff who will use unpaved roads during construction of the Project shall be informed of the 15 mph speed limit.

Soils

- Application of erosion protection in accordance with the revegetation plan will consist of the application of straw over the standard revegetation seed mixture and/or redistributed topsoil, to prevent erosion.
- Construction vehicles will be confined to designated roads and parking areas to prevent compaction of outlying areas.

Vegetation

- Coso shall crop or crush, not blade, vegetation underneath and along the pipeline corridor, except in any areas required for above ground supports (see Figure 1, Pipeline and Related Infrastructure), which shall be cleared.
- The pipeline corridor shall be revegetated according to the revegetation plan.
- Coso shall gain and maintain access to the pipeline by pruning, not by destruction of existing vegetation through clearing or blading.
- Construction equipment and vehicles shall be cleaned to remove dirt and any vegetative material prior to accessing the site. This will reduce the potential for introduction of invasive or noxious species.
- Prior to construction, monitoring shall occur to determine the presence of noxious or invasive species on or adjacent to the pipeline corridor. Any removal program must be approved by the BLM in advance of its implementation.
- The pipeline corridor shall be monitored for five (5) years after completion of construction. Any noxious or invasive species found will be reported to the BLM and control measures will be developed and implemented only after review and approval by the BLM.
- During construction, the pipeline corridor shall be monitored for special-status plant species. Any populations of special-status species shall be identified and avoided through rerouting of the pipeline within the surveyed corridor.

Groundwater

- The Project Proponent shall implement the Hydrologic Monitoring and Mitigation Plan as approved by Inyo County.

Wildlife

- The pipeline corridor shall be revegetated according to the revegetation plan for the proposed Project.
- Preconstruction biological monitoring shall be conducted to identify any possible tortoises or ground nesting birds within the pipeline alignment. Any potential tortoise, Mohave ground squirrel burrows or ground nesting sites in the alignment shall be examined prior to construction to assure their avoidance.
- A tortoise-proof exclusion fence shall be installed around the proposed Project construction area including staging areas and laydown sites; the fencing shall be maintained throughout construction and all work shall be conducted within the fenced areas.
- A qualified biological monitor shall be on site during all phases of construction. The biological monitor shall ensure that the tortoise fencing remains in place and that all work occurs in place within the fenced areas.
- All construction workers shall be briefed as to measures to avoid impacts to desert tortoise and other special-status species. These measures shall include proper disposal of solid waste, no driving in areas outside of the tortoise enclosures, and the exclusion of pets and firearms from the Project site.
- The Project Proponent shall debit 48.42 acres from its remaining acreage credit allowance under the approved Mohave Ground Squirrel Mitigation Plan.
- The Project Proponent shall obtain an incidental take permit with respect to the Mohave ground squirrel to authorize incidental takes that may occur on private land in connection with the Project, and shall satisfy all habitat compensation requirements of the California Department Fish & Game as a condition of that authorization.
- The Project Proponent shall comply with all avoidance measures to be specified by the U.S. Fish and Wildlife Service in a biological opinion addressing the desert tortoise.

Cultural Resources

All sites found in the Project APE will be avoided during construction by shifting the proposed pipeline to within the paved or gravel roadway (Gill Station Road). This avoidance includes a 30-meter (98-foot) buffer zone around large sites (INY-1863, INY-2125, INY-4413, and CGP-2), and a 10-meter (33-foot) buffer zone around small ones (INY-3406 and CGP-1). A cultural monitor is required to be on site during any construction activities within any avoidance area, along with the temporary placement of orange environmental fencing to protect the sites.

Native American Values

- BLM will ensure that the pipeline route and construction avoids the six archaeological sites located within the APE.
- A qualified archeologist and Native American monitor will be present during all construction activities.
- CLNAWS has been monitoring the geophysical state of the Coso Hot Springs on a monthly basis as a provision of the 1979 Programmatic Memorandum of Agreement (Programmatic MOA) among the

Navy, SHPO and the ACHP. This Programmatic MOA is related to the construction of the initial geothermal facility, and continues to report annually on the monthly observations of the Coso Hot Springs. This report is then distributed to the signatory and concurring parties.

- CLNAWS has been coordinating the visitation and use of the Coso Hot Springs by Native Americans and Traditional Practitioners since 1979 as a provision of the 1979 Programmatic MOA.
- If changes in use patterns by the Traditional Practitioners resulting from the implementation of the undertaking are identified, BLM and CLNAWS will initiate consultation among the signatory and concurring parties regarding the observed changes.

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APPENDIX A
BLM/NAWS Memorandum of Understanding

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PROGRAMMATIC MEMORANDUM OF AGREEMENT
BETWEEN
THE COMMANDER, NAVAL WEAPONS CENTER,
CALIFORNIA STATE HISTORIC PRESERVATION OFFICER
ADVISORY COUNCIL ON HISTORIC PRESERVATION

PURPOSE

This proposal establishes a process for mutual agreement between the Commander, Naval Weapons Center, China Lake, California; the California State Historic Preservation Officer; and the Advisory Council on Historic Preservation in the preservation and protection of historic and cultural property that may be affected by the Navy Geothermal Development Program in the vicinity of Coso Hot Springs, Inyo County, California, which is located on the Naval Weapons Center.

Each of these entities is concerned with the protection of historic and cultural property located on the Naval Weapons Center in compliance with requirements set forth in statutes for the protection of cultural resources. Since the proposed undertaking could have an adverse effect on historic and cultural property, the parties to this Agreement concur that it would be in the best interest of such property and of expeditious geothermal development to coordinate the process for locating, identifying, evaluating, protecting and preserving historic and cultural property in advance of and from activities relating to the development of the Navy Coso Geothermal Development Program.

The proposed action is the award of a contract to develop geothermal power as an alternative to conventional power sources at the Naval Weapons Center (NWC), China Lake, California. The contractor will be responsible for implementing a Coso Geothermal Development Program on approximately 3 1/2 square miles of 4 1/2 square miles of Navy fee-acquired land within the Coso Known Geothermal Resource Area (Coso KGRA). Execution of the contract will be subject to constraints that will facilitate development of the geothermal resource and without interference with the Naval Weapons Center's national defense mission. Successful completion of this project will provide the Navy energy self-sufficiency at its NWC facility. Energy in excess of the NWC needs will be made available to other west coast Department of Defense activities thereby releasing to the civilian sector electrical power generating capacity now devoted to defense requirements.

The proposed program is to develop geothermal resources only on Navy fee-acquired land within the Coso KGRA. The Navy geothermal development program is distinct and totally separate from the leasing program for withdrawn and public land within the Coso KGRA being considered by the Bureau of Land Management (BLM). NWC and BLM executed a Memorandum of Understanding in 1977 permitting BLM to lease land in the Coso KGRA, withdrawn under Public Land Order 431, for geothermal development by private industry. BLM has initiated a separate environmental assessment to evaluate the impact of leasing both public and withdrawn land in the Coso KGRA for geothermal development.

Because the Navy geothermal development program is not based on a lease of the geothermal resource, the Navy conducted its environmental review in a manner that differs from the BLM. The Navy will prepare a tiered or phased series of environmental reviews as described in Paragraph 1502.20 of the recently proposed National Environmental Policy Act Regulations and as proposed in "Program Objectives of the Interagency Geothermal Streamlining Task Force." By doing so, Navy expects to avoid the problems inherent in making detailed speculative projections of potential effects on historic and cultural resources without specific knowledge of the geothermal resource and the geothermal reservoir.

The Navy Coso geothermal development program is based on processing of the Navy-owned geothermal resource by a contractor. The rights to the geothermal resource will not be conveyed to the contractor. The Navy will not commit the resource to full development at the time of contract award. This distinction will be made explicit in the contract by defining decision points between the various stages of development, for example, between field exploration and field development. Using the tiered concept, these decision points will allow detailed evaluation of specific effects of each operational stage on historic and cultural resources without duplicating previous reviews and without lengthy reviews of hypothetical effects.

The Navy obtained fee-simple title to approximately 4 1/2 square miles of land in the project area in 1947 as a result of civil condemnation (311-ND). In January 1978, approximately 1 square mile of the Navy's land was listed on the National Register of Historic Places. Due to the combination of an apparent lack of significant geothermal resource within the National Register site and the complexity inherent in conducting new activities within a registered site, only the 3 1/2 square miles of surface outside of this site will initially be made available for geothermal development under the proposed contract. The location of the 3 1/2 square miles selected for development is shown in Figure 1, a foldout on the last page of this Agreement. The project area consists of four separate parcels extending from the eastern edge of Rose Valley on the west to Coso Basin on the east.

The four discrete locations of fee-acquired lands discussed herein are assigned letter designations as follows and are identified in Figure 1.

Parcel A: The westernmost parcel located in Rose Valley contains a total of 640 acres.

Parcel B: The central and largest parcel consists of approximately 1,315 acres. This parcel contains the Coso Hot Springs NATIONAL REGISTER site.

Parcel C: The northernmost parcel contains 40 acres.

Parcel D: The southernmost parcel lying on the edge of the Coso Basin consists of 320 acres.

All proposed geothermal wells must be drilled on Navy fee-acquired land. The support, conveyance, and power generation facilities may be constructed on either fee-owned or adjacent withdrawn land within NWC boundaries, subject to Navy approval. At no time will ownership of the land or the geothermal resource be conveyed to the contractor.

Any production of by-products from the produced geothermal fluids must be specifically approved by the Navy. Distribution of any income derived will be subject to the law in existence at the time by-product production is proposed.

The electric generation system provided by the contractor will be integrated with the commercial power grid to the degree required to maintain a reliable and economic power supply to the activities served.

GEOTHERMAL DEVELOPMENT PROGRAM

The proposed contract will require the contractor to prepare a Geothermal Development Program to be implemented at his expense. The program must address how the following development phases will be conducted:

(a) Field investigation and research

(b) Field exploration

(c) Field development and power plant construction

(d) Power production and field operation

(e) Field closure

Before proceeding from one phase of development to the next, mutual agreement on the economic, technical, and environmental feasibility must be reached by the contractor and the Navy. Should the resource at Coso prove unsuitable for economic power generation at the then present state of the art, the contractor can withdraw. If the geothermal resource is suitable for power production, the contractor shall build, own, operate and maintain one or more geothermal plants and necessary power lines, power transformer substations and associated equipment and facilities to deliver initially the full electrical energy requirements of NWC and subsequently other Navy activities. The government will reserve the right to purchase all contractor-owned facilities and cancel the contract at any time for reasons of national security, national defense preparedness, or national emergency.

The above description illustrates the manner in which the project contract characteristics will provide the overall decision-making framework for future development of Navy-owned resources in the Coso KGRA. It is not a detailed development plan; it is a broad program with phases that cannot be defined in detail until each previous phase has been completed. Detailed evaluations of potential effects on historic and

cultural resources will be prepared for public review at each stage of the program and will be used to determine the feasibility of the next phase, as defined by the contractor. Evaluation of cumulative effects will be conducted at each review stage; modifications to original projections of cumulative effects will be made as new information indicates such changes are merited.

In order to project effects on historic and cultural resources resulting from geothermal development, it is necessary to characterize the most significant land uses associated with development of the geothermal resource. A Coso Geothermal Development Model describing the decision-making points has been developed for Navy fee-acquired lands at Coso. The model identifies the types of man-made actions required at each stage of development.

Field Investigation Research

A substantial body of geologic and geophysical data has already been compiled regarding the geothermal resource at Coso. The contractor will use this information plus any additional data that is available to select exploratory drill site locations. It is anticipated that this phase of the operation will be limited in terms of time and in the amount of additional field data that will be required.

The typical activities conducted during this phase include airborne exploration; surface surveys; and subsurface investigations (seismic surveys and temperature gradient holes). The deep research hole, Coso Geothermal Exploratory Hole No. 1, (CGEH-1) drilled by the Department of Energy to evaluate the hot dry rock potential at Coso represents a specialized data gathering effort that will not be duplicated by the contractor in his investigation and research phase.

These activities involve small numbers of people and vehicles. The potential for permanently affecting historic or cultural resources during this phase is minimal. Drilling of seismic test and/or temperature gradient holes represents the most intensive land use. Small truck-mounted drill rigs can drill to the required depths for seismic and temperature gradient tests. Effects on historic or cultural resources are minor at this stage and can be readily mitigated.

All vehicular traffic and/or ground disturbing activities in the Field Investigation Research phase shall be limited to existing roads, trails or disturbed areas.

Field Exploration

Given a favorable prognosis based on evaluation of research data, the contractor will design a program to drill exploratory geothermal wells at selected locations. Geothermal well drilling designed to penetrate the deep geothermal reservoir requires a portable, oil well type drilling rig, sufficient water for drilling, and an adequate power supply. Each drilling site requires sufficient area for a mud or waste fluid pit, the rig itself, and its support facilities.

The total size of the well pad can vary from 3 to 5 acres, depending on a variety of factors such as pit size, topography, and power supply. Air compressors are normally provided for this stage of drilling. Existing roads may require improvement and new access roads may have to be constructed.

Up to 1,000 barrels of water (42,000 gallons) are consumed per day in drilling a well depending on subsurface condition and drilling technique used.

Once completed, an exploratory well is tested (allowed to flow freely) to evaluate its productive capacity. During this period, which includes well clean-out and flow testing, the geothermal fluid (hot water) or vapor (steam) is allowed to flow into the waste discharge pit where it largely evaporates. The geothermal fluid can contain a variety of dissolved and suspended solids. The flow produces substantial noise levels requiring muffling, and is commonly accompanied by noncondensable gases. Flow testing will remove only small volumes of fluid from the reservoir, depending on the length of the flow test and the rate of flow. The total volume of fluid brought to the surface during a flow test will seldom exceed several acre feet.

Once the flow testing is completed, and depending on whether the resource is hot water or steam, an exploratory well can be permanently shut-in if it is not commercially productive, or it can be converted to a production well at a later date if the flow is adequate.

Field Development and Power Plant Construction

At the conclusion of the field exploration phase, the contractor will have collected enough information to decide whether the field will support commercial energy production. The field development phase consists of drilling wells and laying the steam gathering and related pipelines, power plant construction, and installation of transmission lines and disposal systems and constructing roads and pads.

Actual field development will take place over an extended period of time as new wells are drilled until the field is developed to its maximum sustainable capacity. During the development phase, construction activity and the size of the work force will be at its maximum.

Because the nature of the geothermal resource has not yet been defined, a description of the specific development activities and the amount of land and other resources required at Coso by these activities cannot be estimated with precision. Estimates for the amount of land by type of land use include the following:

Land use	Approximate area affected
Well pads	3-5 acres per pad
Roads:	
temporary graded (12-feet wide)	1.5 acres per mile of road
permanent (24-feet wide). . . .	2.9 acres per mile or road
Pipeline corridors. . . . . (10-feet wide).	1.2 acres per mile of corridor
Transmission line corridor. . . . (100-feet wide, but 25 feet of disturbed area)	3 acres per mile of corridor
Power generation. . . . . plant	5 acres for a 50-megawatt plant
Geothermal and power plant. . . . support facilities	2.5 square feet per square foot of structure

As the geothermal field is defined, the nature and character of the reservoir in combination with protection of the NWC mission capability will be the primary determining factor in the general location of well sites, pipelines, power plant, roads and transmission lines. Environmental factors such as topography, geologic hazards, and historic or cultural resources will determine the specific location of geothermal facilities.

Power Production and Field Operation

During this phase, the principal activity will consist of operation and maintenance of the existing facilities and the continuation of field development, including siting of additional power plants. Development and production and operation phases will continue to overlap until the geothermal resource is fully developed. As field development is completed, the work force will be reduced to plant and field operation and maintenance personnel. Power generation can be expected to continue for an indefinite period.

The most significant waste products are noncondensible gases, fluid remaining after flashing to provide steam and the condensate. At this

time, the volume and character of these wastes is undefined and the potential effects of their generation and disposal cannot be specifically projected.

A variety of disposal and pollution control techniques have been developed at other geothermal fields, which can be adapted to control or reduce waste discharge effects on the environment at Coso. Accumulated wastes must either be processed into valuable by-products or disposed of in appropriate disposal sites.

Field Closure

The productive life of a geothermal field has not been determined because all the existing operating fields continue to produce energy. It is possible that geothermal reservoirs can be considered a resource which, if managed properly, can continue to produce energy indefinitely; however, if the resource at Coso should gradually become depleted, the field would have to be abandoned or converted to a lower grade energy use.

Land use activities associated with field closure would include removal of some or all facilities, abandonment and capping of wells as appropriate, and remedial actions to reclaim all disturbed areas. However, these facilities may prove to be of value to the Naval Weapons Center test range programs active at that time. Materials and facilities that can be recycled should be recovered and the remaining materials will have to be disposed of in appropriate disposal sites. Wells should be left in a safe condition for future use. Remedial surface rehabilitation activities will vary, according to NWC range use requirements.

As described above the proposed contract requires the contractor to complete detailed evaluations of potential effects on historic and cultural resources as well as all other environmental impacts for public review at each phase of the geothermal development program as well as an evaluation of cumulative effects. In this way last minute discoveries of any sites not previously identified can be protected, preserved, or data recovery operations can be performed as appropriate.

HISTORIC AND CULTURAL RESOURCES MANAGEMENT PROGRAM

The objectives of the historic and cultural resources management program outlined herein are as follows:

A. To provide appropriate and expeditious execution of all identification, evaluation, preservation and where necessary data recovery operations at each phase of the geothermal development program.

B. To ensure the collection and dissemination of reliable and scientifically valid information about affected cultural properties within the Navy fee-acquired lands in the Coso KGRA.

Authority

1. An Act for the Preservation of American Antiquities, 1906 (34 Stat L. 225)

2. National Historic Preservation Act of 1966 (80 Stat 925), as amended (90 Stat 1313)

3. Executive Order 11593 of 1971

4. Reservoir Salvage Act of 1960 (74 Stat 220, 221) as amended by the Archeological and Historic Preservation Act of 1974 (88 Stat 174)

5. Procedures for the Protection of Historic and Cultural Properties (36 CFR Part 800), and the Proposed amendments thereto published in the Federal Register Vol. 43, No. 210 of October 30, 1978.

6. Public Land Order 431 of 1947

7. 311-ND of 1947

Definitions

1. Historic and Cultural property: remains of past human activity, occupation or endeavor as reflected in districts, sites, structures, buildings, objects, artifacts, ruins; works of art, architecture, and natural features that were important in human events. These properties consist of (1) physical remains, (2) areas where significant human events occurred--even though evidence of the event no longer remains, and (3) the environment surrrounding the actual resource.

2. Mitigation: the lessening of possible adverse effects of an action upon a historic or cultural property by appropriate preservation, protection and/or data recovery measures.

Historic and Cultural Property Management

The Commander, Naval Weapons Center, agrees that he will implement the proposed undertaking in accordance with the following process to avoid or satisfactorily mitigate any adverse effects on significant historic or cultural property.

1. The Navy geothermal development contractor will be required to allocate sufficient funds and time in advance of implementation of any element of the geothermal development progress to perform adequate historic and cultural surveys, to analyze recovered materials, to prepare and disseminate resultant reports, and to implement the historic and cultural property management program.

2. The historic and cultural property management program for Navy Coso Geothermal Development Program will cover the entire project and its

related facilities including all areas that would be directly or indirectly affected by the geothermal development program.

3. The Commander, Naval Weapons Center, will administer the historical and cultural property management program for the Navy Coso Geothermal Development Program to ensure quality control of all program elements, proper phasing of investigations with decision-making points, and procedural compliance with pertinent statutes and regulations.

4. The Commander, Naval Weapons Center, will ensure that the contractor performs the phased reviews and evaluations of historic and cultural resources in a competent professional manner in compliance with 36 CFR 61.5 and other pertinent regulations, Federal or State.

5. The historic and cultural property stipulations of this proposal will be incorporated into the programmatic environmental review process.

6. The Commander, Naval Weapons Center, will ensure that the following measures will be carried out at the appropriate development phase:

a. Prior to commencement of any project-related undertaking, locate, identify, and evaluate all historic and cultural property that has been included in, determined eligible for inclusion in, or that may be eligible for inclusion in the National Register of Historic Places through a complete surface field survey following an existing data study including, but not limited to, archival and literature research, ethnographic research, museum research, and oral history. Data produced by such investigations will become a part of the statewide survey of cultural resources maintained by the California State Historic Preservation Officer. These activities are to be carried out under valid Federal and State Antiquities Permits for investigation on Federal land.

b. Determinations of a property's potential eligibility for inclusion in the National Register of Historic Places and of the effects of the project on such properties, will be made by the Commander, Naval Weapons Center, in coordination with the California State Historic Preservation Officer. Documentation on all properties found to meet the criteria for inclusion in the National Register of Historic Places will be forwarded to the Office of Archaeology and Historic Preservation pursuant to 36 CFR Part 63.3. In situations where the Commander, Naval Weapons Center, and the California State Historic Preservation Officer disagree as to eligibility, a written request for a determination of eligibility will be sent to the Keeper of the National Register, Office of Archaeology and Historic Preservation, pursuant to 36 CFR Part 63.2

c. Avoid by project redesign or project relocation, where prudent and feasible, the historic and cultural properties included in or eligible for inclusion in the National Register of Historic Places.

d. Develop and implement, in consultation with the California State Historic Preservation Officer, appropriate means for protecting historic and cultural properties included in or eligible for inclusion in

the National Register of Historic Places. These means may include, but need not be limited to signing, patrolling, fencing, erosion control, preservation, relocation, salvage, and other physical or administrative measures.

When it is neither prudent nor feasible to avoid a cultural property, the Commander, Naval Weapons Center will provide a report documenting that fact to the California State Historic Preservation Officer.

e. The Commander, Naval Weapons Center, will establish baseline data on the seasonal activity of some 40 steam wells and boiling mud pits at Coso Hot Springs sufficient to permit systematic monitoring for any effect that may be caused over time by the geothermal development program. Additionally, at each tiering phase of the development program re-evaluation of the monitoring techniques and the surface activity of the hot springs will be conducted.

Prior to the installation of monitoring devices at the hot springs, the Commander, Naval Weapons Center, will consult with the Owens Valley Band of Paiute-Shoshone Indians to fully inform them of plans for monitoring and the expected benefits from monitoring the surface activity. A description of the monitoring program will be forwarded to the Board of Trustees for the Owens Valley Paiute-Shoshone Band of Indians and to the California State Historic Preservation Officer for review and comment.

Present knowledge of the hydrogeology of Coso Hot Springs indicates that the fluids at the springs are not interconnected with the deep geothermal reservoir; therefore the geothermal development program is not expected to affect their surface activity. Criteria shall be developed by the Navy to detect perceptible change to the surface activity of Coso Hot Springs which will be offered to the Board of Trustees for the Owens Valley Paiute Shoshone Band of Indians and to the California State Historic Preservation Officer for review and comment prior to implementation of the second phase (Field Exploration) of the geothermal development program. In the event a perceptible change to the surface activity of the hot springs were to occur over a period of time as a result of the geothermal development program the Navy will cease those actions on the part of the Navy and/or its agents which can reasonably be presumed to be causing this effect and will make every reasonable effort to determine what actions could be taken to mitigate this change. The Navy will request the comments of the Owens Valley Paiute-Shoshone Band of Indians, the California State Historic Preservation Officer and the Advisory Council on Historic Preservation. The Owens Valley Paiute-Shoshone Band of Indians will be afforded 30 working days to comment and the California State Historic Preservation Officer will be afforded 30 working days to comment, these times to run concurrently. If the California State Historic Preservation Officer, the Advisory Council on Historic Preservation and the Navy cannot agree on actions which would adequately mitigate these effects, the Navy will request consultation with the Advisory Council in accordance with Title 36 of the Code of Federal Regulations, Chapter VIII, prior to undertaking any actions which could reasonably be presumed to result in a further detrimental change in the Springs' activities.

. Hot springs such as Coso which are located on geologically young faults and in highly seismic areas are not permanent features but are apt to be changed or eliminated by natural forces.

f. Consultation with the California State Historic Preservation Officer.

(1) If it is determined that the affected historical or cultural property is eligible for inclusion in the National Register of Historic Places primarily because it may be likely to yield information important in prehistory or history, and does ~~not~~ meet ~~[illegible]~~ the criteria as detailed in Part I of the "Guidelines for Making 'Adverse Effect' and 'No Adverse Effect' Determinations for Archeological Resources in Accordance with 36 CFT Part 800", the Commander, Naval Weapons Center, will ensure that the contractor institutes a data recovery program in consultation with the California State Historic Preservation Officer, in accordance with Part II of the Council's "Guidelines for Making 'Adverse Effect' and 'No Adverse Effect' Determinations for Archaeological Resources in Accordance with 36 CFR Part 800", without affording the Council further opportunity to review and comment.

(2) If it is determined that the affected historic or cultural property is eligible for inclusion in the National Register of Historic Places primarily for any other reason, the Commander, Naval Weapons Center after determining the effect of the action on the property will obtain the comments of the California State Historic Preservation Officer on a preliminary case report including the following information:

-A general description of the proposed undertaking with explanatory material.

-A description of the properties included in or eligible for inclusion in the National Register of Historic Places affected by the undertaking, identifying the significant features of the properties.

-An evaluation of the effect of the undertaking upon the properties included in or eligible for inclusion in the National Register of Historic Places.

-A discussion of measures taken in considering the undertaking's effect on the properties included in or eligible for inclusion in the National Register of Historic Places, including an indication of the support or opposition of units of government, as well as public and private agencies and organizations and a review of alternatives that would avoid any adverse effects.

-A proposal for a course of action to be implemented that would mitigate the adverse effect.

(5) Upon completion of the preliminary case report it, with the comments of the California State Historic Preservation Officer, will be forwarded by the Commander, Naval Weapons Center to the Advisory Council on Historic Preservation, for comment as required by the "Proce-

dures for the Protection of Historic and Cultural Properties" (36 CFR 800). In the interim no action will be approved by the Navy that could result in an adverse effect on the subject cultural property.

d. In emergency situations, where the procedure outlined in "a" above does not apply, when the time to undertake adequate mitigation is short, where failure to act in a short time would result in project construction delays, and an agreement on an emergency mitigation plan has been reached by the Commander, Naval Weapons Center and the California State Historic Preservation Officer, the Commander, Naval Weapons Center will forward the preliminary case report with the proposed mitigation plan to the Advisory Council on Historic Preservation requesting an expeditious review and comment. Within 10 working days of receipt of such documentation the Executive Director will notify the Commander, Naval Weapons Center, that the proposed mitigation is sufficient and he is preparing the required Memorandum of Agreement, or that he notes an objection. If an objection is noted the Executive Director will work with the Commander, Naval Weapons Center and the California State Historic Preservation Officer in an attempt to satisfy his concerns, or request that the Chairman schedule a special meeting of the Council to consider the matter. If the Executive Director objects, until the objection is resolved, no action will be approved by the Commander Naval Weapons Center that could result in an adverse effect on the subject historic or cultural property.

7. The Commander, Naval Weapons Center, will within 5 working days bring to the attention of the California State Historic Preservation Office and the Owens Valley Paiute-Shoshone Band of Indians any cultural property discovered as a result of any action relating to the geothermal development program. The Commander, Naval Weapons Center, in coordination with the California State Historic Preservation Officer will protect and evaluate such discoveries and will determine within 5 working days what action will be taken with respect to such discoveries, including protection as provided for in Section 106 of the National Historic Preservation Act of 1966 and other relevant statutes.

8. Reports of progress at each developmental phase of the geothermal program, and a final program report on the results of all cultural property operations will be distributed by the Commander, Naval Weapons Center, to the California State Historic Preservation Officer, and to the Owens Valley Band of Paiute-Shoshone Indians. Report standards will be of appropriate professional quality.

9. Artifacts and other cultural materials recovered from Naval Weapons Center lands will, after analysis, be curated in accordance with professional practices and stored at a repository designated by the Smithsonian Institution.

10. One year from the date of ratification of this Agreement by the Chairman of the Council, and annually thereafter until the geothermal development program is completed, the Commander, Naval Weapons Center and the California State Historic Preservation Officer will review the program established by the Agreement and submit to the Council an assessment of

the progam operation, with copies of the tiered review reports prepared by the contractor. Unless modified, this Agreement will continue in effect.

11. Should any party to this Agreement desire to amend or alter the provisions herein, all parties agree to make an effort to negotiate an acceptable amendment or alteration within thirty (30) days after written notification. In the event a mutually acceptable resolution cannot be reached by the signatories within thirty (30) days, the consultation process provided by Title 36 of the Code of Federal Regulations, Chapter VIII, Part 800, shall be initiated by the Naval Weapons Center.

12. This Memorandum of Agreement is executed in three (3) original copies, each of which contains the official text.

Kay McClellan
STATE HISTORIC PRESERVATION OFFICER

NOV 5 1979
DATE

William B. Haff
COMMANDER, NAVAL WEAPONS CENTER

OCT 18 1979
DATE

CHAIRMAN, ADVISORY COUNCIL ON
HISTORIC PRESERVATION

DATE

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APPENDIX B
BLM to USFWS Sec. 7 Letter

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United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Ridgecrest Field Office
300 South Richmond Road
Ridgecrest, CA 93555-4436

IN REPLY REFER TO:
6840/2880(P)
CACA-046289
CA-650.25

SEP 16 2008

Memorandum

To: Field Supervisor, Ventura Field Office, U.S. Fish and Wildlife Service

From: Field Manager, Ridgecrest Field Office, Bureau of Land Management

Subject: Request for Formal Consultation Regarding the Coso Hay Ranch Pipeline, Inyo County, California

The Ridgecrest Field Office of the Bureau of Land Management (BLM) wishes to rescind its letter requesting concurrence from the U.S. Fish and Wildlife Service for a determination pursuant to 50 CFR 402.14, that the pipeline construction for the Coso Hay Ranch project may affect, but is not likely to adversely affect, the desert tortoise. The desert tortoise is federally listed as threatened with designated critical habitat and a completed recovery plan (1994). This project is not in critical habitat. After further review of new data, we have determined that the project is likely to adversely affect the desert tortoise.

The Environmental Impact Report prepared by Inyo County contains all pertinent information with regard to the biological findings. The proposed pipeline and the Gill Station Coso Road were surveyed most recently in 2007 and sign found within the zone of influence for both. These findings are the reason for our new determination. The Bureau of Land Management, Ridgecrest Field Office wishes to initiate formal Endangered Species Act consultation, pursuant to 50 CFR 402.14, for the Coso Ranch pipeline right-of-way.

Pursuant to the implementing regulations for section 7(a)(2) of the Endangered Species Act at 50 CFR 402.14(c), we are providing the required information for initiation of formal consultation by referencing the environmental impact report prepared by the County of Inyo. The required information and its page numbers in the environmental impact report follow:

(1) A description of the action to be considered – [EIR]
(2) A description of the specific area that may be affected by the action – [Page 3.4-1 through 3.4-44]

(3) A description of any listed species or critical habitat that may be affected by the action – [Page 2.4-6 through 2.4-16]

(4) A description of the manner in which the action may affect any listed species or critical habitat and an analysis of any cumulative effects – [3.4-23 through 3.4-38];

Ray Bransfield of your staff has informed up that the County of Inyo has provided you a copy of the draft environmental impact report (402.14(c)(5)) and that no further information is needed to satisfy 50 CFR 402.14(c)(6).

Please contact Robert Parker (760) 384-5425 of the BLM Ridgecrest Field Office for additional information or questions.

Attachments:
Coso EIR Bio Sections

cc:
Endangered Species Coordinator, California State Office (w/o encl.)
Larry LaPré, Endangered Species Coordinator, California Desert District Office (w/o encl.)
Environmental Planning & Management Department, NAWS (w/o encl.)
Chris Ellis (w/o encl.)
Colleen Brock (w/o encl.)

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APPENDIX C

1988 Mohave Ground Squirrel Stipulation and Mitigation Plan

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LT Thomas M. Bayne
Naval Weapons Center (Code 007)
China Lake, CA 93555
Telephone: (619) 939-2203
Representative for: Naval Weapons Center, China Lake

STATE OF CALIFORNIA
STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

In the Matter of: Application for a Small Power Plant Exemption for the Coso Navy 2 Geothermal Project	Docket No. 88-SPPE-1 STIPULATION FOR THE MITIGATION OF IMPACTS TO THE MOHAVE GROUND SQUIRREL AT THE COSO KNOWN GEOTHERMAL RESOURCES AREA

1. The attached Stipulation, with explanatory documents, bears obvious relevance to the Small Power Plant Exemption process.

2. The Stipulation of October 4, 1988, consists of 7 pages. The companion materials total 20 pages and are intended to afford an insight into those discussions and developments which led to the present Stipulation.

Dated: 10/27/88

Thomas M. Bayne
Naval Weapons Center
Geothermal Legal Advisor

Proof of Service filed with original.
Mailed from Ridgecrest, CA on 27 October 1988.

10/27/88 H285
1246 NAVY I + II

STIPULATION FOR THE MITIGATION OF IMPACTS TO THE MOHAVE GROUND SQUIRREL AT THE COSO KNOWN GEOTHERMAL RESOURCE AREA (KGRA)

GOALS AND OBJECTIVES

The goal of this mitigation plan is to offset adverse impacts and to assure no net loss to the state-listed (threatened) Mohave ground squirrel (MGS) resulting from geothermal exploration and development in the Coso KGRA. The objectives of this mitigation plan are:

A. to develop and implement specific actions which will:
   - enhance known Mohave ground squirrel habitat not permanently used for geothermal power purposes;
   - create more favorable conditions within the disturbed areas by means of rehabilitation of temporarily disturbed areas;
   - relieve competitive pressure on the MGS; and,
   - reduce both short and long term impacts.

B. to provide a mechanism, in the form of a "mitigation bank," whereby all geothermal developers at Coso KGRA can participate in the mitigation program.

SCOPE OF THE PLAN

This plan is designed to provide mitigation for a maximum of 2158 acres of surface disturbance on the China Lake Naval Weapons Center (NAVWPNCEN), and up to 35 acres of disturbance outside the boundaries of the NAVWPNCEN on public lands within the Coso KGRA. Once the 2,193 acres of approved surface disturbance has been reached, no further disturbance may be permitted under this mitigation plan; at that point additional mitigation measures must be developed and approved by the cognizant agencies. "Surface disturbance" includes long-term as well as short-term (temporary) disturbance except for acreage disturbed for conductor stringing of transmission lines. Also, all lands disturbed by geothermal development within the Coso KGRA prior to initiation of this plan shall be included in the total of disturbed lands.

This document is a reformulation of the original Coso geothermal resource area Mohave ground squirrel mitigation plan that was approved in March 1988, by NAVWPNCEN and The Bureau of Land Management (BLM) and concurred in by the California Department of Fish and Game (CDFG). The plan as originally written remains unchanged. This stipulation merely represents a reorganization of all requirements into a single comprehensive document. For reference, the original MGS mitigation plan is contained in Appendix A of this document.

APPROACH

The approach adopted in this plan involves both active and passive techniques for attaining the aforementioned goal. Active techniques include habitat enhancement

actions (brush piles, exclusion of exotic ungulate competitors, revegetation) while passive techniques include habitat maintenance actions (minimum surface disturbance, lowered vehicle speed limits, management of geothermal fluid sumps).

The basic hypotheses of this plan are:

- Adequate mitigation can be achieved through development and implementation of a sound plan.
- The MGS population is in balance with other animals sharing the habitat.
- Significant temporal and spatial changes in the MGS population can be detected and can be related to both geothermal activities and habitat enhancement management actions taken under this plan.

THE PLAN

The MGS mitigation plan consists of six major elements which are all interrelated, and the effects of which will likely be difficult to distinguish one from another. These elements are:

1. Exclusion of grazing by cattle and burros.
2. Surface disturbance management.
3. Creation and enhancement of favorable habitat.
4. Institution of indirect mitigation actions.
5. Conduct of a baseline data acquisition and monitoring program.
6. Establishment of a funding mechanism.

1. Grazing Limitation

It is believed that significant adverse ecological pressure is brought to bear on the MGS population by the presence of cattle and burros. These animals compete with the MGS for scarce food supplies and may destroy MGS habitat through trampling.

The primary aspect of the grazing limitation requires the construction of a grazing exclosure consisting of a five-strand barbed wire fence excluding herbivores from 43,500 acres of land as shown in Figure 1. The fence will be constructed and completed between June 1, 1989 and November 30, 1989. The fence shall be maintained throughout the active life of the geothermal field. Effectiveness of the exclosure will be evaluated during the 1990-91 grazing season by means of the monitoring plan.

Also as part of this mitigation element, the feral burro management program will continue on the NAVWPNCEN and the surrounding BLM lands. One objective of this equine management program is to remove all exotic ungulates from the Coso KGRA development area.

Further, a water source shall be provided for cattle outside the exclosure. The site of the source shall be determined by the BLM in consultation with the grazing allottee.

2. Surface Disturbance Management

The basic tenets of surface disturbance management are:

- in all possible instances, disturbed areas will be reclaimed at the earliest possible time.
- for any given geothermal activity a minimum amount of surface area will be disturbed.
- all surface disturbance will be limited to approved areas.

Specifically, surface disturbance management will include:

a. minimizing size and number of well pads.
b. utilizing multiple wells per pad wherever feasible.
c. using existing access roads wherever possible.
d. minimizing the width and length of new roads.
e. re-contouring all piles, pits, sumps, and other disturbed areas as soon as possible, after it is determined they are no longer needed.*
f. revegetating disturbed areas immediately after cessation of surface disturbing operations.*
g. leaving pockets of native vegetation in place wherever possible to hasten re-establishment of native flora.
h. stockpiling the top 2" to 6" of topsoil removed from construction sites. This topsoil shall be redistributed over areas that are being revegetated.
i. cut and fill slopes shall be at least 2:1, not steeper unless approved in writing by the authorized officer.

3. Conservation and enhancement of habitat

It is believed that habitat for Mohave ground squirrels can be both conserved and enhanced by using some fairly simple practices during surface disturbance activities. Vegetation from construction sites and drill pads should be grubbed, crushed, and stockpiled in previously disturbed areas. Further, it should be placed so as not to obstruct the natural drainage channels. These brush piles provide added cover for small reptiles, insects, and mammals such as the MGS.

4. Indirect mitigation actions

These actions were previously referred to as passive techniques or habitat maintenance procedures. It is not known that these procedures will directly benefit the MGS, but it is generally agreed that MGS will accrue some benefits as will all other wildlife. In some instances, the actions

(*NOTE: according to specifications agreed upon by BLM and NAVWPNCEN)

described below have other ancillary environmental benefits outside of those for wildlife, e.g., lowered speed limits generally mean less airborne dust.

a. Speed limits of 25 mph shall be observed on all secondary range roads within the KGRA. This will reduce the likelihood of roadkills.
b. Open reserve sumps and mud pits shall only be used for containment of drilling and geothermal fluids during drilling operations, well testing, and emergency situations, unless specifically authorized by BLM and NAVWPNCEN.
c. Side slopes of fluid sumps or pits shall be graded to a 2:1 ratio to allow greater likelihood of escape for wildlife that may fall into the pits.
d. All trash, equipment, and waste shall be removed and properly disposed of as soon as possible.
e. Hazardous waste shall be placed in approved containers and disposed of at authorized sites outside of the NAVWPNCEN.

5. Baseline and Monitoring Program

In order to assess the effectiveness of this mitigation plan, a baseline data acquisition and monitoring program will be conducted. Details of this program are contained in Appendix A, "Scope of Work, Baseline and Monitoring Study of Proposed Coso Grazing Exclosure, Coso Known Geothermal Resource Area," by Philip and Barbara Leitner (March 12, 1988, as revised).

Baseline data will be acquired in calendar years 1988 and 1989. Monitoring will continue through the year 2000.

BLM and NAVWPNCEN, in conjunction with the CDFG and other invited parties, shall review the baseline and monitoring data on a periodic basis (to be established by mutual agreement). BLM, NAVWPNCEN, and CDFG will determine if the mitigation measures have met, exceeded, or fallen short of the goal and objectives of this plan. These reviews shall also produce recommendations for modification of the plan, as necessary, to increase the likelihood of attaining the goal and objectives.

Alternative mitigation may include, but is not limited to, expansion of the grazing exclosure, offsite habitat improvement, and rehabilitation of disturbed areas or other acceptable MGS measures continuing for the term of the impacts of the project. The final disposition of impacts at any given site will be addressed in the plans of abandonment and reclamation filed by the developers for that site.

6. Establishment of a funding mechanism

Geothermal developers which agree to participate in this mitigation package shall participate in funding the Mohave ground squirrel mitigation bank. California Energy Company and China Lake Joint Venture shall fund the entire cost of the mitigation bank. California Energy Company, et al.

shall make provisions to allow other developers to contribute to the bank on a pro rata basis based on their acreage of disturbance. The amount contributed shall be sufficient to cover all costs associated with the mitigation described in this plan. Specifically, the mitigation bank shall be used to:

a. fund the cattle and burro exclusion element.
b. fund the baseline data acquisition and monitoring element.

COMPENSATION PROTOCOL

The following factors will be considered by the NAVWPNCEN, BLM, and CDFG in determining the effectiveness of the Coso Mohave Ground Squirrel Mitigation Plan:

1. The effectiveness of the exclosure will be evaluated during the 1990-1991 grazing season (see: Estimate of Grazing Pressure, Final Study Design).

2. In September 1993, the chief scientist for the monitoring study will present results of MGS trapping conducted between 1988 and 1993 to representatives of BLM, NAVWPNCEN, and CDFG. This presentation will include calculations of the relative abundance and/or population densities of MGS on the four study sites, computed using at least three different technically recognized methodologies. The chief scientist will include his recommendation as to the most appropriate method(s) to use in expressing the abundance of MGS on the study sites. The agencies will then agree upon and adopt one or more methods of determining MGS abundance.

3. The basin and bajada lands within the Coso grazing exclosure are considered capable of producing measurable increases in carrying capacity for the MGS, as these areas appear to be favored by the species and to receive the majority of cattle use. Figure 2 shows basin and bajada areas within the Coso grazing exclosure. These areas are calculated to total 19,308 acres.

4. Total disturbed acreage will be calculated on an annual basis by means of the ground-verified surface disturbance data provided by each developer, and spot-checked by the agencies.

5. The recovery of vegetation within the exclosure will be measured per the description in the Final Study Design. The quality of the shrub cover will be defined, as well as the species composition and total standing crop of the herbaceous layer.

6. Revegetation plans will be developed and implemented and will include monitoring and follow-up to assess the success in reclaiming disturbed lands.

In the year 2000, the NAVWPNCEN, BLM, and CDFG will individually and collectively evaluate the results of the baseline data acquisition and monitoring program within the context of the six factors mentioned above to determine the effectiveness of the Mitigation Plan. Correlations will then be derived between MGS population trends, habitat improvement, and habitat loss resulting from geothermal operations. These correlations will enable the agencies to determine if additional

mitigation will be required to offset adverse impacts and to assure no net loss to the MGS. Establishment of strict formulas for judging the success of the Mitigation Plan in advance of a more complete suite of baseline and monitoring data being in hand is not justifiable. A preliminary value of approximately 13% increase of MGS on study plots has been identified as a target to measure the success of the mitigation plan if the entire projected surface disturbance occurs. This value is subject to revision by mutual agreement of BLM, NAVWPNCEN, and CDFG when further baseline data become available. At such time as more analyzed data are available, representatives of the three aforementioned agencies will reevaluate the success criteria and make revisions as appropriate.

ROLES AND RESPONSIBILITIES

Following is a description of the major roles and responsibilities of the key players in the implementation of this mitigation plan.

1. Geothermal Developers. This includes Navy contractors and all BLM lease holders and operators within the Coso KGRA. All present and future developers shall either participate in this mitigation plan or develop alternative mitigation measures acceptable to BLM and NAVWPNCEN and concurred in by CDFG.

Geothermal developers which agree to participate in this mitigation package shall contribute a pro rata amount to the Mohave ground squirrel mitigation bank. Starting in 1989, each participant in this mitigation package shall maintain ground verified records of surface disturbance acreage and report these to BLM and NAVWPNCEN annually on or before January 31.

2. China Lake Naval Weapons Center. NAVWPNCEN is the ultimate responsible agency for all matters related to surface use on NAVWPNCEN lands, and is the subsurface manager for the Navy fee title lands within the KGRA. As such, NAVWPNCEN is committed to leasing and development of geothermal resources on NAVWPNCEN lands provided it can be done in a manner that is compatible with the military mission of NAVWPNCEN. NAVWPNCEN is also committed to ensuring that the mitigation plan is executed within the areas of NAVWPNCEN permitting authority, and will continue its feral equine management at Coso KGRA.

3. Bureau of Land Management. Pursuant to the authority of Public Land Order 5942 (May 18, 1981) which provides for leasing of certain lands within the China Lake Naval Weapons Center for geothermal resource development and the related Memorandum of Understanding between BLM and NAVWPNCEN, BLM was granted certain rights to administer Federal leases on a portion of the Coso KGRA. As lessor, BLM has responsibility for managing all surface and subsurface activities on its leases within approved areas of operations so long as such activities do not interfere with the primary mission of the NAVWPNCEN. BLM is also responsible for ensuring that all of its lessees adhere to terms and conditions of their leases and plans of operation derived therefrom. With NAVWPNCEN, BLM jointly approves environmental analyses of proposed actions on land within their purview. The BLM agrees to

include this mitigation plan in all permits it issues within the Coso KGRA and to require developers to adhere to its terms through the life of the geothermal operations. In the event cattle are found in the exclosure area, BLM shall oversee their removal within 10 days.

4. California Department of Fish and Game. CDFG is the state trustee agency responsible for the protection and management of the state's fish and wildlife, including state-listed rare, threatened and endangered species.

The BLM, NAWWPNCEW and CDFG will (1) annually review the results of the monitoring study, (2) review the acreages of disturbed lands as submitted by the developers, (3) review the success of the mitigation program and review the revegetation efforts. During January 1993, after three years of cattle exclusion, the agencies shall meet to evaluate the extent to which the mitigation goal has been met and to determine the current value of the mitigation program. If by the year 2000, the monitoring study fails to show that the mitigation program has accomplished its goal, or if the acreage of disturbed lands exceeds 2,193 acres at any point in time, the agencies shall develop alternative measures (to be implemented by the Geothermal Operators) that will provide complete compensation for geothermal resource development impacts on the MGS at the Coso development area.

Approved By:

Date 10/4/88
Patricia E. McLean
Area Manager
Ridgecrest Resource Area
Bureau of Land Management

Date 5 Oct 88
Carl P. Austin
Head, Geothermal Program Office
Public Works Department
China Lake Naval Weapons Center

Concurrence By:

Date 10/7/88
George D. Nokes
Regional Manager
Department of Fish and Game
State of California-The Resources Agency

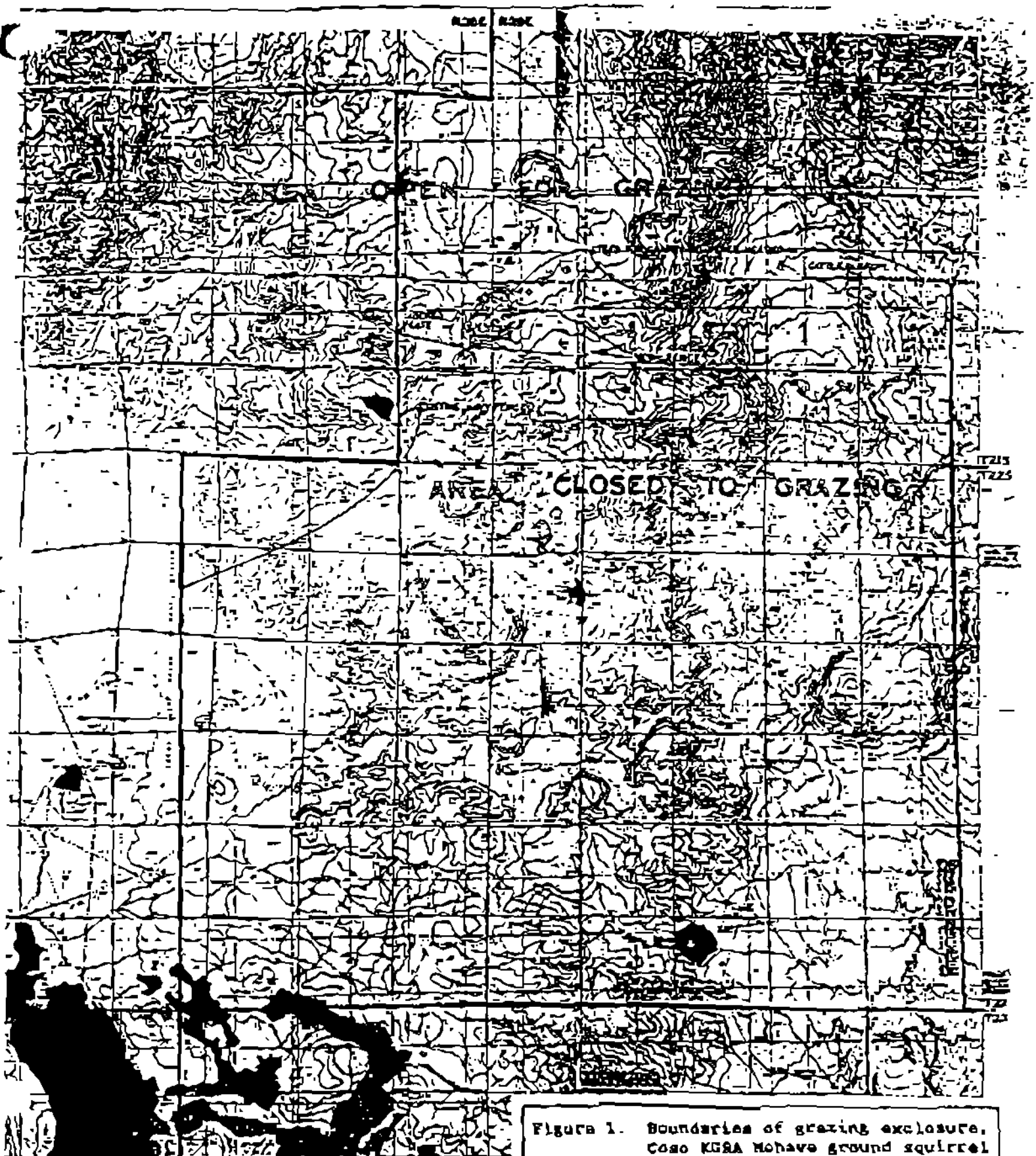

Figure 1. Boundaries of grazing exclosure, Coso KGRA Mohave ground squirrel mitigation plan.

APPENDIX A

APPROVED MOHAVE GROUND SQUIRREL

MITIGATION PLAN

STIPULATION FOR THE MITIGATION OF IMPACTS TO THE MOHAVE GROUND SQUIRREL

These stipulations will be referenced in all surface disturbance permits approved after concurrence of the 1988 mitigation plan by the California Department of Fish and Game, for geothermal operations proposed by California Energy Company, Inc., China Lake Joint Venture, and Los Angeles Department of Water and Power within the China Lake Naval Weapons Center (NAVWPNCEN) portion of the Coso Known Geothermal Resource Area (KGRA) and for transmission line facilities associated with the geothermal operations. This stipulation requires developers to either become signatories to the approved mitigation plan or to develop alternative mitigation in consultation with the California Department of Fish and Game.

The approved mitigation plan is described as follows: The geothermal developers have agreed to contribute to a mitigation bank, henceforth referred to as "bank". Funds from this bank will be expended to achieve the mitigation measures listed below. The developers' funding responsibility for this bank is detailed in the "Implementation Agreement for Cost Sharing, Mohave Ground Squirrel Mitigation Plan."

The developers' responsibilities under the mitigation plan include:

1. The bank will provide for construction of a five-strand barbed wire fence at locations shown on Exhibit A in the fall of 1989, and maintenance of this fence throughout the active life of the geothermal field. Since the objective of the mitigation plan is to exclude exotic herbivores from some 38,000 acres of KGRA lands, the effectiveness of the fence in excluding cattle will be evaluated during the 1990-91 grazing season. If cattle are continuing to enter the

exclosure, there will be consultation between developers and the regulatory agencies to determine additional methods which will achieve the objective of exclosure.

2. The bank will fund a baseline and monitoring study, as detailed in Exhibit B. The first year of baseline data collection will be 1988. The last year will be 2000.

3. The bank shall establish a water source for cattle outside the exclosure at a site to be determined by the NAVWPNCEN in consultation with the rancher. Signatories to the Implementation Agreement (developers), the NAVWPNCEN, the Bureau of Land Management (BLM), and the California Department of Fish and Game (CDFG) may meet in late 1988 or early 1989 at the recommendation of the monitoring study's project lead scientist or the regulatory agencies. The purpose of this meeting would be to review the results of the baseline study, in order to refine sampling methodology. The project lead scientist or the regulatory agencies may call meetings annually thereafter to review results of the previous year's study.

The funding of the last year of monitoring, in the year 2000, is contingent upon continuation of geothermal operations. Operations will be considered abandoned, and the last year of monitoring will not be required, if Plans of Abandonment have been filed by all developers before the year 2000.

4. Each environmental document submitted to the NAVWPNCEN or BLM must include an update of the acreage of cumulative surface disturbance from geothermal operations. Surface disturbance includes both those lands committed to operations for the life of the project and those lands revegetated immediately after disturbance. Lands temporarily disturbed during stringing of conductors are not included in the count of acreage disturbed. Each developer will maintain ground verified records of surface disturbance acreage and make the records available to regulatory agencies and other developers.

5. The following set of operating conditions shall be observed:

a. Pad sizes shall be minimized and access to the project area shall be confined to existing routes to the extent possible to reduce habitat loss. Existing access to the pads will be used wherever possible; if new access spurs must be developed, they shall be of the minimum width and length needed to accommodate equipment and operations.

b. Stockpiled bladed vegetation and excavated materials shall not obstruct the natural flow of water down wash systems. Vegetation and other materials removed during grading or construction should be stored on previously disturbed sites in order to reduce impacts to additional habitat and to stabilize soils by reducing erosion caused by wind and water. Stockpiled vegetation and topsoil will be used to facilitate revegetation.

c. To reduce the potential for drowning of Mohave ground squirrels, open reserve sumps and mud pits shall only be used for containment of drilling and geothermal fluids during drilling operations and well testing, and containment of emergency flows. Side slopes on fluid sumps or pits will be graded to a 1:2 ratio to allow wildlife to escape.

d. Whenever possible, pockets of native vegetation will be left to hasten re-establishment of native flora.

e. To minimize the potential for roadkills of Mohave ground squirrels, a speed limit of 25 mph shall be observed on all secondary range roads within the KGRA.

f. All drill holes will be plugged and abandoned according to Geothermal Resources Operational Order #3.

g. All piles, pits, sumps and other disturbed areas shall be recontoured to either BLM or NAVWPNCEN specifications upon site abandonment, according to instructions from the responsible agency (BLM or the NAVWPNCEN).

h. All disturbed areas no longer required for operations shall be revegetated immediately after cessation of operations, per BLM and NAVWPNCEN direction.

i. All trash, equipment and waste shall be removed and properly disposed of as soon as possible. Hazardous waste (such as hydraulic fluids and crankcase oil) shall be properly containerized and disposed of at authorized sites outside of the NAVWPNCEN.

j. Any proposed activities not previously authorized will not be allowed without specific approval from the responsible agency (BLM or the NAVWPNCEN).

6. Developers will be responsible for enforcement of all stipulations through on-site enforcement or compliance officers. The name and telephone number of the responsible compliance officer shall be provided to the NAVWPNCEN with submittal of Sundry Notice applications.

SCOPE OF WORK

BASELINE AND MONITORING STUDY OF PROPOSED COSO GRAZING EXCLOSURE

COSO KNOWN GEOTHERMAL RESOURCE AREA

Philip and Barbara Malloch Leitner

March 12, 1988

BACKGROUND AND JUSTIFICATION

Early reservoir estimates suggested that up to 2500 megawatts of electric generating capacity might be developed in the Coso Known Geothermal Resource Area (KGRA). At present a 25 megawatt demonstration unit is in operation, and up to 226 megawatts additional capacity is planned. Up to 848 acres of desert scrub habitat is committed to development or soon to be committed as part of projects built or under consideration. This amounts to 3.3 acres per megawatt under present engineering design and reservoir characteristics; future development may require a higher or lower land surface-to-megawatt ratio.

Biological resource studies conducted in the Coso KGRA in 1978 and 1979 demonstrated that much of the area with the highest potential for geothermal development supports the Mohave ground squirrel (Spermophilus mohavensis), a species listed as threatened by the California Department of Fish and Game (CDFG). CDFG has indicated that loss of Mohave ground squirrel habitat is an issue of significance and that mitigation measures developed for previously-permitted projects are no longer adequate. CDFG priority for mitigation is to compensate for lost Mohave ground squirrel habitat by enhancing remaining habitat. Such on-site, in-kind mitigation may, of course, benefit other indigenous wildlife species as well.

Geothermal resource developers currently active in the Coso KGRA (California Energy Company, Inc. and the Los Angeles Department of Water and Power) have expressed interest in a comprehensive biological resource mitigation program addressing full-field development impacts of up to 2,260 acres as estimated in the Bureau of Land Management Leasing EIS (BLM 1980). Discussions between the developers and CDFG concerning biological resource mitigation have been ongoing and a variety of compensation alternatives have been discussed. Meetings in January and February, 1988, between the developers and resource managing agencies (U.S. Navy, BLM and CDFG) culminated in an agreement to develop a comprehensive mitigation plan.

The central goal of the mitigation program is elimination of grazing pressure by domestic cattle. Cattle may adversely impact the Mohave ground squirrels directly, by competing with

them for limited forage; or indirectly, by trampling ground squirrel burrows and by reducing shrub cover necessary for ground squirrel thermoregulation and protection from predators.

The specific goals of the Mohave ground squirrel mitigation plan are:

1) To improve the quality of remaining habitat for the Mohave ground squirrel within the geothermal development area, given present knowledge about its habitat requirements;

2) To evaluate the effectiveness of the habitat improvement program; and

3) To develop information about habitat requirements that may be used to more clearly define the relationship between the Mohave ground squirrel and livestock.

This scope of work is directed toward satisfaction of the second and third objectives. Concurrent with development of this scope of work, implementing agreements between developers, surface and resource managing agencies are being prepared. These agreements will set forth actions required to exclude cattle from the managed area, the entity responsible for each action, the timetable, and cost-sharing arrangements.

OBJECTIVES OF THIS STUDY

1. Document the existing baseline status of the Mohave ground squirrel and its environment in the Coso KGRA, with emphasis on its potential competitors and the plant populations of greatest importance to the Mohave ground squirrel.

2. Monitor the status of the Mohave ground squirrel in the Coso KGRA after establishment of the Coso Grazing Exclosure, with emphasis on the Mohave ground squirrel's potential competitors and the plant populations on which it depends.

STUDY PLAN

I. Schedule

In the desert environment, plant and animal response to removal of grazing pressure is likely to be a slow process. Therefore, baseline and monitoring studies must be conducted over a number of years. The proposed schedule is as follows:

1988 Baseline study
1989 Baseline study
Coso Grazing Exclosure established in Fall 1989 (includes fencing, control of water sources)

1991 Monitoring study
1993 Monitoring study
1995 Monitoring study
2000 Monitoring study (contingent on continuation of the geothermal project)

Baseline studies must be scheduled for both 1988 and 1989 because of 1) the potential for significant year-to-year fluctuation in environmental variables such as rainfall and primary production and resultant fluctuations in Mohave ground squirrel population levels from year to year; and 2) the need to test and validate sampling methodologies being tailored to this specific study and site.

Extension of monitoring studies out to ten years after establishment of the exclosure is necessary in order to 1) document changes in shrub parameters (desert shrubs grow slowly and at least a decade of elapsed time can be required to show signficant changes); and 2) evaluate the long-term persistence of trends in Mohave ground squirrel populations.

II. Study Design

A. Study Site Selection

Four permanent study sites will be established, two within the Coso Grazing Exclosure that are currently receiving use by cattle, and two nearby in similar habitat that will continue to be subject to regular use. The study sites will be 500 by 500 meters in size, comprising 25 hectares (about 60 acres). Two natural communities, Mohave mixed woody scrub and Mohave creosote bush scrub, are the most widespread and extensive communities in the KGRA: the study sites will represent these communities both within and outside the grazing exclosure. Criteria for selection are as follows:

1) natural community present;
2) topography, soils, slopes;
3) estimated intensity of use by livestock;
4) presence of adequate numbers of Mohave ground squirrels to make useful between-year comparisons;
5) likelihood of geothermal or other surface disturbance through the year 2000; and
6) ease of access and acceptability to surface managing agencies (Sites within the Naval Weapons Center will be subject to Navy approval).

Preliminary field studies will be carried out in March and April 1988 for the purpose of selecting the four study sites. By April 30, the sites will be selected and submitted to participating entities.

4

B. Vegetation Studies

Vegetation studies will document the condition of both shrub and herb layers. Shrub condition, including recruitment of new individuals, is a function of grazing pressure and weather events and tends to change slowly. Shrubs may be most important to Mohave ground squirrels as shade for thermoregulation or as cover against predators while foraging on the herbs beneath. Herbaceous vegetation made up the majority of the diet of Mohave ground squirrels studied in northwestern Los Angeles County (Recht, 1977). Although vital as a principal food source, the biomass and species composition of desert annuals may fluctuate considerably from year to year based on weather conditions.

Shrub sampling will document cover, species composition and recruitment. The methods employed will be subject to review as information is obtained on Mohave ground squirrel habitat requirements. One approach is to use methods similar to Henrickson's (1980) field surveys as part of the Coso KGRA EIS; these are step-point and line-intercept methods. Another is to fly low-elevation aerial photography (flown in conjunction with other studies); this would provide a permanent record of shrub species composition, cover, and frequency for each 60-acre study plot. This method would permit flexible analysis of the data by plot subsections to test relationships between ground squirrel densities and the structure of the shrub layer. Recruitment must be measured in the field using a method such as belt transects in which the number and species of shrubs below a certain size limit are noted. The shrub measurements may be taken once during the baseline period, once in 1993, and once in the year 2000.

The herbaceous layer, which is more variable from year to year, will be sampled each year that live-trapping is carried out. Species composition and cover estimates will be recorded in small plots. Standing crop (above-ground biomass) will be measured in the field using air-dry weights at the end of the sampling period (late June). The between-shrub herbaceous layer and the under-shrub layer will be sampled separately, since plant production and rodent use in each may be quite different. When food-habits studies are in progress, the phenological condition of annual plants will be recorded as an indicator of food availability and moisture content, factors suggested by Recht (1977) as critical to the Mohave ground squirrel.

The exact methodology for vegetation sampling should be tailored to measure those habitat parameters most important to the Mohave ground squirrel. The sampling program may be modified based on information gathered as part of the food habits study (see below). For example, if a limited number of plant genera are determined to be of particular importance, more quantitative methods may be employed to monitor these species.

C. Wildlife Studies

Food Habits Study. Little is known of the food habits of the Mohave ground squirrel. The most detailed study was based on observations of a small number of animals at a site in northwestern Los Angeles County (Recht, 1977). No information is available concerning food habit overlaps between the Mohave ground squirrel and potential competitors, in this case, antelope ground squirrel, black-tailed jackrabbit, cattle and feral burros. Therefore, a food habits study will be carried out during the first year of the baseline period. Data will be gathered on important seasonal foods for the Mohave ground squirrel and its potential competitors. It should aid in developing more focused vegetation surveys and in interpreting trends in Mohave ground squirrel trapping studies.

Analysis of fecal samples is preferred over stomach-content analysis, since no sacrifice of animals is required. Samples can readily be obtained from live-trapped animals. Samples will be collected six times at three week intervals throughout the four month period when the Mohave ground squirrel is most active, April-July 1988. Frequent sampling is needed because Recht (1977) found that Mohave ground squirrels shifted from one principal food source to another several times during their active season. Ten samples will be taken at six intervals from each of the four study sites, for a total of 240 samples. As indicated in the previous section, the phenological condition of local plant species will be collected at each sampling interval to help develop information on food availability.

Analysis will also include fecal samples of other herbivores which potentially compete with the Mohave ground squirrel. Fecal samples of antelope ground squirrels will be taken during the live-trapping studies. Jackrabbit, burro and cattle fecal material will be collected, as available through the sampling period, and analyzed for comparison.

Methods for analysis will follow standard procedures outlined in the Wildlife Management Techniques Manual (Korschgen, 1980) and those used by Terry Foppe at the Composition Analysis Laboratory at Colorado State University, Ft. Collins. A reference collection of slides containing epidermal cells of local plant species and genera will be developed. Fecal analysis studies will be augmented with field observations of Mohave ground squirrel foraging behavior during the principal live-trapping period in May and June (see below). Comparison of food availability (through vegetation studies), food selectivity (through direct observation) and digestibility (by comparing direct observations with fecal analysis) should provide a reasonably clear picture of the food habits of the Mohave ground squirrel, as well as provide some indication of overlap with the food requirements of other local herbivores.

Estimate of Grazing Pressure. Information is sketchy on the grazing pressure presently posed by cattle within the Coso KGRA, since the area comprises only a portion of an allotment. Woodward and McDonald (BLM 1980) concluded that the range within the proposed exclosure area was in poor condition due to prolonged overutilization. In the past two years, an estimated 70-150 head of cattle used the range within the proposed exclosure for a six-month winter period (November-May); however, this level of use is less than previous use as estimated by BLM and projected future use without the grazing exclosure. Once range condition has improved as a result of current feral burro management efforts, the lessee will be allowed to return to stocking rates approximately double those now in effect.

Livestock use will be quantified by walking transects and recording the number of droppings by species. All droppings will be spray-painted when counted. Transects will be walked both before and after establishment of the Coso Grazing Exclosure (in 1986 and 1991 in each of the study sites) as well as in selected areas throughout the KGRA. Photopoints will be established in the study sites to document range condition.

Sampling for Mohave Ground Squirrel. The relative abundance of Mohave ground squirrels will be determined on each of the four study sites by mark-recapture sampling using a standard live-trapping technique. Each 500 by 500 meter site will be used as a trapping grid. A total of 441 Sherman live traps will be deployed in a 21 x 21 trap grid with 25 meter spacing between trap stations. All sampling will be conducted between May 20 and June 30, when Mohave ground squirrels are most active. Trapping will be carried out for five days at each site. Traps will be open for approximately four hours in the early morning and (if feasible) for an equivalent period in late afternoon. All animals captured will be marked for individual recognition and released unharmed. Traps will be shaded to prevent injury to ground squirrels from overheating.

This technique will provide data on the relative abundance of Mohave ground squirrels at each study site, ratio of juveniles to adults, body mass, home range size, and movements. It may be possible to estimate the number of squirrels present on each study site or to estimate actual population density, although this will not be known until the results of the 1988 baseline study are available for analysis. Because of the intensive trapping effort over a relatively large area (25 hectares), the technique should be sensitive enough to detect significant year-to-year changes in important population parameters.

Received Time Feb. 4 11:28AM Print Time Feb. 4 11:48AM

REPORTING AND REVIEW SCHEDULE

A comprehensive annual report will be completed by the end of each calendar year in which studies are carried out. This report will be distributed to all cooperating entities involved in the study. The results of the study or any of its components will become available for publication in appropriate scientific journals or for presentation at scientific meetings and conferences. All cooperating entities will have the right to review manuscripts prior to publication or public presentation. In addition, a coordinating meeting will be held once annually with the agencies and the geothermal resource developers to report on progress to date, to evaluate costs, to solicit technical input from participating entities, and to resolve questions as they come up.

REFERENCES CITED

Bureau of Land Management. 1980. Coso Leasing EIS. Bureau of Land Management, Bakersfield, CA.

Henrickson, James. 1980. Botany of the Coso Geothermal Study Area. In: Rockwell International, 1980, Field ecology technical report on the Coso Geothermal Study Area in support of Coso Geothermal Development Environmental Statement. Bureau of Land Management, Bakersfield, CA. 97 pp.

Korschgen, Leroy J. 1980. Procedures for food-habits analyses. Pp. 113-128 In: Wildlife management techniques manual. Sanford Schemnitz (ed.). The Wildlife Society, Washington, DC (Fourth edition).

Recht, Michael Anthony. 1977. The biology of the Mohave ground squirrel, Spermophilus mohavensis: home range, daily activity, foraging and weight gain and thermoregulatory behavior. University of California, Los Angeles, Ph. D. dissertation. 117 pp.

DEPARTMENT OF THE NAVY
NAVAL WEAPONS CENTER
CHINA LAKE, CALIFORNIA 93555-6001

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Varanini
Hopkins
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Phil Essner
California Energy Company, Inc.
601 California Street, Suite 900
San Francisco, CA 94108

Dear Mr. Essner:

Enclosed is a copy of the interagency letter adopting California Energy Company's proposal to modify a portion of the Mohave ground squirrel Mitigation Plan for geothermal development at Coso. The proposal was approved by the Bureau of Land Management and the Naval Weapons Center on February 20, 1990. California Department of Fish and Game formally concurred on February 27, 1990. We understand from our discussions with your Company's management at Coso District that fieldwork implementing the Plan modification will begin this spring .

If you have any questions concerning this matter, you may call me at (619) 939-3411, extension 229. We look forward with interest to the results of this year's baseline studies.

Sincerely,

Carolyn A. Shepherd

CAROLYN A. SHEPHERD
Environmental Manager
Geothermal Program Office

Enclosure: Interagency Letter

Copy to: (w/o encl)
California Energy Company, Inc. (Coso District)
Bureau of Land Mangement/Ridgecrest (L. Delaney)

03/06/90 E537

United States Department of the Interior
BUREAU OF LAND MANAGEMENT
RIDGECREST RESOURCE AREA
112 East Dolphin Avenue
Ridgecrest, California 93555
(619) 375-7125

TAKE PRIDE IN AMERICA

IN REPLY REFER TO:
3200
(CA-065.52)

FEB 20 1990

Mr. George Nokes
Department of Fish and Game
Region 4
1234 E. Shaw Avenue
Fresno, California 93710

Dear Mr. Nokes:

I am writing this letter in behalf of the Bureau of Land Management and the Navy, China Lake Naval Weapons Center to present a proposal changing a portion of the Mohave ground squirrel Mitigation Plan for development at the Coso Geothermal Area and to seek your concurrence with these changes.

Background

On March 10, 1988, a plan for mitigating impacts to the Mohave ground squirrel as a result of field development and production at the Coso Geothermal Area was forwarded for your review and concurrence. The plan was reviewed and concurrence issued by your office on March 22, 1988. During the following months, the specific goals and objectives, scope and detailed elements of the plan were refined by the interested regulatory agencies and the geothermal developer. On October 5, 1988, a reformulation of the original plan was released for your review and concurrence was issued on October 7, 1988. This document was titled "Stipulation of the Mitigation of Impacts to the Mohave Ground Squirrel at the Coso Known Geothermal Resource Area" and shall hereafter be referred to as the MGS Mitigation Plan.

Results of Prior Studies

On page four (4) of the MGS Mitigation Plan under Part 5 is the section entitled "Baseline and Monitoring Program". Paragraph three of this section states, "BLM and NAVWPNCEN, in conjunction with the CDFG and other invited parties, shall review the baseline and monitoring data on a periodic basis (to be established by mutual agreement). BLM, NAVWPNCEN, and CDFG will determine if the mitigation measures have been met, exceeded or fallen short of the goal and objectives of this plan. These reviews shall also produce recommendations for modification of the plan, as necessary, to increase the likelihood of obtaining the goal and objectives."

The baseline studies as proposed in this section, specifically during the years of 1988 and 1989, have been completed. The 1988 study results have been formally reviewed and the 1989 results have been distributed for review. A comparison of the 1988 study results to the 1989 study results yielded interesting information that affects the establishment of a representative baseline from which future comparisons will be made.

During the 1988 study season, the trapping of the study sites occurred between May 25th and June 30th. To summarize, both juvenile and adult populations of the MGS were captured, with the juveniles far outnumbering the adults. The biological consultants, Phillip and Barbara Leitner, noted this fact but offered no firm explanation in the 1988 report. During the 1989 study season, the four sites were again trapped in May and June. In addition, a portion of study site 3 which was also trapped during March and April in order to collect fecal samples for food habits analysis. The March and April trapping period yielded adult populations of the MGS only. No juveniles were captured. During the May and June trapping periods, only a small number of adults were captured and juveniles were nonexistent. A close comparison of the data gathered during the 1988 and 1989 seasons indicates that the best time to trap the adult population of the MGS, which represents the most stable fraction, is the early spring during March and April.

Proposed Changes in the MGS Mitigation Plan

The proposed changes in the MGS Mitigation Plan are presented in the enclosure. In summary, the baseline study will be extended for one year. The principal investigators propose to trap during March and April and also attach radiotransmitters to determine when the adult population enters estivation. Population estimates will be aided by the use of a new marking technique. Tiny microchips will be injected subcutaneously to provide permanent identification for each ground squirrel. Portions of the grazing exclosure fence will remain open to allow baseline grazing conditions to continue.

Conclusion

In light of the results of the 1988 and 1989 studies, the baseline studies should be extended for one year to conclusively determine the representative baseline populations of the Mohave ground squirrel at the four study sites. The proposal as presented by the principal investigators is adopted as a change in the MGS Mitigation Plan. Further work, which may be required as a result of the 1990 study will be considered only for 1991. The baseline must be established by the end of the 1991 study year.

We look forward to your concurrence with this proposed change. Should you have any questions or comments please feel free to contact Pete Milne or Carolyn Shepherd at (619) 375-7125 (Pete) and (619) 939-2700 (Carolyn).

Approved By:

Date 2/20/90
Lee Delaney
Area Manager
Ridgecrest Resource Area
Bureau of Land Management

Date 30 Feb 90
Carl F. Austin
Head, Geothermal Program Office
Public Works Department
China Lake Naval Weapons Center
By direction of the Commander

Concurrence By:

Date 2/27/90
George D. Nokes
Regional Manager
Department of Fish and Game
State of California-The Resources Agency

Received Time Feb. 4 11:03AM Print Time Feb. 4 11:46AM

Use the Bookmark Feature in Acrobat to return to Main Menu

APPENDIX D
Programmatic Agreement

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Preserving America's Heritage

July 7, 2008

Mr. Mike Pool
State Director, California State Office
Bureau of Land Management
2800 Cottage Way, Suite W1834
Sacramento, CA 95825

Ref: Programmatic Agreement among the United State Bureau of Land Management, Ridgecrest Field Office, the California State Historic Preservation Officer, and the Advisory Council on Historic Preservation regarding the Hay Ranch Water Extraction and Delivery System

Dear Mr. Pool:

Enclosed is the executed Programmatic Agreement for the referenced program. By carrying out the terms of this Agreement, the Bureau of Land Management will have fulfilled its responsibilities under Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's regulations, 36 CFR Part 800, implementing Section 106 of the National Historic Preservation Act.

Should you have any questions, please contact Nancy J. Brown, who can be reached at 202-606-8582 or nbrown@achp.gov.

Sincerely,

Reid Nelson
Assistant Director
Federal Property Management Section
Office of Federal Agency Programs

Enclosure

PROGRAMMATIC AGREEMENT
AMONG THE UNITED STATES BUREAU OF LAND MANAGEMENT,
RIDGECREST FIELD OFFICE,
THE CALIFORNIA STATE HISTORIC PRESERVATION OFFICER, AND
THE ADVISORY COUNCIL ON HISTORIC PRESERVATION
REGARDING
THE HAY RANCH WATER EXTRACTION AND DELIVERY SYSTEM

WHEREAS, the United States Bureau of Land Management (BLM) will issue a right-of-way (ROW) to Coso Operating Company LLC (Applicant) for the Hay Ranch Water Extraction and Delivery System (HAY RANCH) which includes the installation of a water pipeline and auxiliary facilities across federal lands (Project); and

WHEREAS, a cultural resources inventory report, entitled *Cultural Resources Inventory for the Hay Ranch Water Extraction and Delivery System, Coso Geothermal Project, Inyo County, California* [Appendix A], has been completed and effects to archaeological resources along the ROW shall be avoided. However, the implementation and operation of the proposed Project may have an effect on Coso Hot Springs (CHS), an historic property included on the National Register of Historic Places (NRHP), but the effects cannot be fully determined at the time of Project approval; and

WHEREAS, the BLM Ridgecrest Field Office is the lead BLM Office for HAY RANCH. BLM will issue the ROW and is responsible for compliance with Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. 470f; NHPA), as amended, and its implementing regulations at 36 CFR Part 800 (August 5, 2004); and

WHEREAS, BLM finds that the issuance of a ROW and Notice to Proceed to construct the HAY RANCH Project is an Undertaking as defined in 36 CFR §800.16(y) and may affect historic properties; and

WHEREAS, CHS is located on fee lands owned and administered by Naval Air Weapons Center China Lake (Navy) and effects to the CHS are monitored and managed pursuant to two agreements: (1) *Memorandum of Agreement between the Commander, Naval Weapons Center, and the Coso Ad Hoc Committee, Owens Valley Paiute-Shoshone Band of Indians (July, 1979)*, and (2) *Programmatic Memorandum of Agreement between the Commander, Naval Weapons Center, California State Historic Preservation Officer and the Advisory Council on Historic Preservation* (November, 1979) [Appendix B], and the Navy has been invited to be a Concurring Party to this PA; and

WHEREAS, pursuant to Section 101(d)(6)(B) of the NHPA, 36 CFR 800.2(c)(2)(ii), the American Indian Religious Freedom Act (42 U.S.C. 1996; AIRFA), Executive Order 13175, and Section 3(c) of the Native American Graves Protection and Repatriation Act (25 U.S.C. 3001-13; NAGPRA), and the Executive Memorandum of April 29, 1994 (59FR22951), BLM has consulted with the Big Pine Paiute Tribe of the Owens Valley, the Bishop Paiute Tribe, the Ft. Independence Paiute Tribe, the Lone Pine Paiute-Shoshone Tribe, the Timbisha Shoshone Tribe,

the Kern Valley Indian Community, and the Tubatulabals of Kern Valley and has invited those Tribes expressing an interest in the Undertaking to concur in this PA, with the further understanding that, notwithstanding any decision by these Tribes to decline concurrence, BLM shall continue to consult with these Tribes throughout the implementation of this PA; and

WHEREAS, in accordance with regulations at 36 CFR §800.14(b)(3) implementing §106 of the NHPA, BLM has consulted with the California State Historic Preservation Officer (hereinafter "SHPO") per 36 CFR §800.6(a), and notified and invited the Advisory Council on Historic Preservation (hereinafter "the ACHP") per 36 CFR §800.6(a)(1)(C) to participate in consultation to resolve the potential effects of the Undertaking on historic properties,

NOW, THEREFORE, BLM, the SHPO, and the ACHP agree that BLM, to the extent of its legal authority, shall ensure that the following stipulations of this PA are implemented to take into account the effects of the Undertaking on historic properties.

A. STIPULATIONS

BLM shall ensure that the following stipulations are carried out:

I. DEFINITIONS

The definitions provided at 36 CFR § 800.16 and in this stipulation are applicable throughout this PA.

"Area of Potential Effects" means those lands within the boundaries of a proposed ROW corridor extending from Hay-Coso Ranch to Well 88-1 of the Coso Geothermal Project. The corridor is approximately nine miles long and fifty feet wide, crossing approximately 33 acres of public lands managed by the BLM, 17 acres of lands managed by the Navy, and 7 acres of private lands. The Area of Potential Effects (APE) also includes the CHS, a property included on the National Register of Historic Places.

"Traditional Practitioner" means an indigenous person who utilizes the CHS for traditional cultural purposes.

"Concurring Parties" means invited parties, including the Navy, Tribes and the Applicant, who concur, through their signature, in this PA. Concurring parties may propose amendments to this PA.

"Signatories" means the BLM, the SHPO, and the ACHP. Signatories may propose amendments to this PA and have the exclusive authority to terminate the PA.

II. DETERMINATIONS OF ELIGIBILITY

For the purposes of this Undertaking, BLM, will assume eligibility and accepts previous National Register of Historic Places (NRHP) determinations of eligibility by consensus or through formal determination by the Keeper of the Register

III. EFFECTS ASSESSMENT

A. BLM shall condition the ROW grant to avoid archaeological properties located within the APE for the pipeline corridor. An archaeologist and Native American Monitor will be present to observe the implementation of this Undertaking. The archaeologist and Native American Monitor shall be present during construction activities to identify and/or ascertain the significance of any subsurface cultural resources or to aid in the avoidance of sensitive areas.

B. The eligibility criterion for the CHS to the NRHP is based on Native American traditional and medicinal use of the CHS. Therefore, the monitoring effort of this PA for CHS will be focused on continued use by Traditional Practitioners.

Under the *1979 Programmatic Memorandum of Agreement*, Navy is responsible for management of the CHS Monitoring Program. The monitoring program established baseline data for miscellaneous springs and wells located within the NRHP. The annual report produced by this effort summarizes monthly temperature data, water levels and chemical composition of the springs and wells. The annual report has been distributed to the Tribes, ACHP and SHPO since the program began. Under this PA, Navy will include BLM on distribution of the annual monitoring report.

Under the 1979 Memorandum of Agreement between Navy and Coso Ad Hoc Committee, Owens Valley Band of Paiute-Shoshone Indians, and the Kern Valley Indian Community, Navy is the lead agency on facilitating requests from Traditional Practitioners to the CHS. The Navy tracks Native American use of the CHS, which has averaged 3 weekend visits per year for the past 20 years. Under the terms of this PA, Navy will provide BLM, SHPO, ACHP and Tribes with an annual written summary of Native American use of the CHS for the preceding year. The BLM will assure the distribution of the annual written summary to all Consulting Parties to this PA.

If changes in use patterns by the Traditional Practitioners resulting from the implementation of this Undertaking are identified, the BLM shall coordinate with the Navy and the other Consulting Parties to this PA to develop a means for addressing effects in accordance with the *1979 Programmatic MOA*.

IV. DISCOVERIES AND UNANTICIPATED EFFECTS

A. Should the Applicant encounter a previously unknown cultural resource during the implementation of the Undertaking, or should the Applicant affect, directly or indirectly,

a known historic property in an unanticipated manner, or where the implementation of the Undertaking may affect a found component of a cultural resource which may be historic, all work within 200 feet of that find shall cease until BLM can evaluate the NRHP eligibility of the find, assess the probable character of the Undertaking's effects on it, and develop a resolution to any effect prior to resuming work. BLM shall consult with the other Signatories and Tribes throughout this process. If a previously unknown cultural resource has been determined to be damaged by the Undertaking, the resource will be assumed eligible for the National Register.

B. The design and execution of data recovery or other mitigation measures (treatment) would be done in consultation with the other Signatories and Tribes. Mitigation measures would be agreed upon among all Signatories after consultation with Tribes. In the event a dispute arises during consultation on appropriate mitigation measures, BLM shall proceed in accordance with stipulation VIII to resolve the issue.

C. Work shall cease in a 200 feet radius around human remains or funerary objects found in association with human remains that are encountered during inventory, evaluation, or treatment phase fieldwork, or during the implementation of the Undertaking. Upon the discovery and recognition of identifiable human remains, BLM shall comply with the appropriate State, County or local laws and regulations, including notifying the County Coroner or other designated official as required in California, as well as the SHPO. BLM will also notify the California Native American Heritage Commission and Tribes if the human remains are determined to be those of Native American descent. If the human remains are determined to be Native American as defined by NAGPRA (Public Law 101-601), the BLM will take responsibility for developing and executing treatment of those remains and the objects found in association with them by implementing that agency's procedures for complying with NAGPRA.

D. In the event that Native American human remains or funerary objects are found in association with such human remains on private or state lands, the Applicant shall treat the remains and objects in accordance with California Public Resources Code 5097.98.

V. NATIVE AMERICAN CONSULTATION

BLM shall consult with the Tribes and other interested parties for issues associated with the implementation of this Undertaking, and serve as the liaison and the coordinator for affairs with the Tribes for the purposes of this Undertaking. Tribal consultation will follow the provisions of the BLM 8120 Series Manual guidance [Tribal Consultation].

VI. STANDARDS

A. **PROFESSIONAL QUALIFICATIONS.** All actions prescribed by this PA that involve the identification, evaluation, analysis, recordation, treatment, monitoring, and disposition of historic properties and that involve the reporting and documentation of

such actions in the form of reports, forms or other records, shall be carried out by or under the direct supervision of a person or persons meeting, at a minimum, the *Secretary of the Interior's Professional Qualifications Standards* (PQS) for archaeology, history, or architectural history, as appropriate (48 FR. 44739). However, nothing in this stipulation may be interpreted to preclude any party qualified under the terms of this paragraph from using the services of properly supervised persons who do not meet the PQS.

B. **DOCUMENTATION STANDARDS.** Reporting on and documenting the actions cited in paragraph A. of this stipulation shall conform to every reasonable extent with the *Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation* (48 FR. 44716-44740), as well as for California, the California Office of Historic Preservation's Preservation Planning Bulletin Number 4(a) December 1989, *Archaeological Resource Management Reports (ARMR): Recommended Contents and Format (ARMR Guidelines) for the Preparation and Review of Archaeological Reports*

C. **CURATION AND CURATION STANDARDS.** To the extent permitted under §§ 5097.98. and 5097.991. of the California Public Resources Code, the materials and records resulting from the actions cited in paragraph A. of this stipulation shall be curated in accordance with 36 CFR Part 79. Where Federal lands are involved, all records and materials resulting from the actions cited in paragraph A. of this stipulation shall be curated in accordance with 36 CFR Part 79 and the provisions of the NAGPRA, 43 CFR Part 10, as applicable.

VII. AMENDMENTS TO THE AGREEMENT

A. Any party to this PA may at any time propose amendments, whereupon all parties shall consult to consider such amendments pursuant to 36 CFR §800.6(c)(7) and §800.6(c)(8). This PA may be amended only upon written agreement of the Signatories after consultation with Tribes and other interested parties.

B. Amendments to this PA shall take effect on the dates that they are fully executed by the Signatories.

C. If the PA is not amended through the above process, any Signatory to this PA may terminate the agreement in accordance with stipulation IX below.

VIII. DISPUTE RESOLUTION

A. Should any party object at any time to the manner in which the terms of this PA are implemented, the BLM will consult with the parties to resolve the objection and immediately notify all Consulting Parties. If BLM determines that such objection cannot be resolved, BLM shall request comments from Consulting Parties on the objection within 30 days, and then proceed to consult with the Consulting Parties for no more than

30 days to resolve the objection. The BLM will take any comments provided by the Consulting Parties into account.

B. If the BLM determines that the objection can be resolved within the consultation period, the BLM may authorize the disputed action to proceed in accordance with the terms of such resolution.

C. If at the end of the 30 day consultation period, the BLM determines that the objection cannot be resolved through such consultation, the BLM will forward all documentation relevant to the objection, including the BLM's proposed resolution, to the ACHP per 36 CFR §800.2(b)(2). Any comments provided by the ACHP within 30 days after its receipt of all relevant documentation will be taken into account by the BLM in reaching a final decision regarding the objection. The BLM will notify the Consulting Parties in writing of its final decision before it is made public. The BLM shall have the authority to make the final decision resolving the objection.

D. The BLM's responsibility to carry out all other actions under this PA that are not the subject of the objection will remain unchanged. The BLM may implement that portion of the Undertaking subject to objection under this stipulation after complying with subsection VIII(C) of this stipulation.

E. At any time during implementation of the terms of this PA, should an objection pertaining to the PA be raised by a member of the public, the BLM shall immediately notify all the Consulting Parties about the objection and how BLM proposes to take the objection into account. The Consulting Parties may comment on the objection to the BLM. In reaching its final decision, the BLM will take into account all comments from the parties regarding the objection. Any dispute pertaining to the NRHP eligibility of historic properties or cultural resources covered by this PA will be addressed by the BLM per 36 CFR §800.4(c)(2).

IX. TERMINATION

A. Only Signatories may terminate this PA. If this PA is not amended as provided for in Stipulation VII A and B, or if a Signatory Party proposes termination of this PA for other reasons, the Signatory proposing termination shall notify the other Consulting Parties in writing, explain the reasons for proposing termination, and consult for no more than 30 days to seek alternatives to termination.

B. Should such consultation result in an agreement on an alternative to termination, the Signatories shall proceed in accordance with that agreement.

C. Should such consultation fail, the Signatory proposing termination may terminate this Agreement by promptly notifying the other Signatories and other Consulting Parties in writing.

D. Should this PA be terminated, then the BLM shall either consult in accordance with 36 CFR §800.14(b) to develop a new PA or request, take into account, and respond to the comments of the ACHP under 36 CFR § 800.7. BLM shall notify the Signatories as to the course of action it will pursue.

X. DURATION OF THIS AGREEMENT

A. Unless the PA is terminated pursuant to stipulation IX above, another agreement executed for the Undertaking supersedes it, or the Undertaking itself has been terminated, this PA will remain in full force and effect for twenty (20) years from the date of execution of this PA. This PA will terminate and have no further force or effect on the day that BLM so notifies the other Signatories and Consulting Parties to the PA or twenty (20) years from the date of execution, unless amended.

B. BLM shall coordinate a meeting of the Consulting Parties to this PA every five (5) years on or about the anniversary of the effective date of the PA, or at the request of a request of a Consulting Party, to review implementation and achieved outcomes of the terms of this PA and to determine whether amendments are needed to improve the effectiveness of this PA.

C. The terms of this PA shall be satisfactorily fulfilled within twenty (20) years following the date of execution by the Signatories. If at any time BLM determines that this requirement cannot be met, the Signatories to this PA will consult to reconsider its terms. Reconsideration may include continuation of the PA as originally executed, amendment, or termination. All parties will be consulted during any reconsideration of this PA. In the event of termination, BLM will comply with stipulation XI(D) if it determines that the Undertaking will proceed notwithstanding termination of this PA.

D. If the Undertaking has not been implemented within five (5) years following execution of this PA by the Signatories, this PA shall automatically terminate and have no further force or effect. In such event, BLM shall notify the other Signatories and Consulting Parties to this PA, in writing, and, if it chooses to continue with the Undertaking, shall reinitiate review of the Undertaking in accordance with 36 CFR Part 800.

XI. EFFECTIVE DATE

This PA shall take effect on the date that it has been fully executed by the ACHP.

EXECUTION AND IMPLEMENTATION OF THIS PA is evidence that BLM has afforded the ACHP a reasonable opportunity to comment on the Undertaking and its effects on historic properties. The Signatories to this PA represent that they have the authority to sign for and bind the entities on behalf of whom they sign.

SIGNATORY PARTIES:

U.S. BUREAU OF LAND MANAGEMENT

BY: _____ DATE: 5/8/08

TITLE: State Director

CALIFORNIA STATE HISTORIC PRESERVATION OFFICER

BY: _____ DATE: 27 MAY 2008

TITLE: [redacted] State Historic Preservation Officer

ADVISORY COUNCIL ON HISTORIC PRESERVATION

BY: _____ DATE: 7/8/08

For TITLE: Executive Director

INVITED CONCURRING PARTIES:

BIG PINE PAIUTE TRIBE OF THE OWENS VALLEY
BISHOP PAIUTE TRIBE
COSO OPERATING COMPANY LLC.
FT. INDEPENDENCE PAIUTE TRIBE
KERN VALLEY INDIAN COMMUNITY
LONE PINE PAIUTE-SHOSHONE INDIAN TRIBE
NAVAL AIR WEAPONS CENTER CHINA LAKE
TIMBISHA SHOSHONE TRIBE
TUBATALABALS OF KERN VALLEY

NAVAL AIR WEAPONS CENTER CHINA LAKE

BY: _____ DATE: 6-5-08

TITLE: Commanding Officer

COSO OPERATING COMPANY LLC.

BY: _____ DATE: 5-13-2008

Joseph Greco
TITLE: Senior Vice President

BISHOP PAIUTE TRIBE

BY: _____ DATE: June 16, 2008

TITLE: Bishop Paiute Tribal Chairman

TUBATALABALS OF KERN VALLEY

BY: _____ DATE: 5/14/2008

TITLE: Tribal Chairwoman

BIG PINE PAIUTE TRIBE OF THE OWENS VALLEY

BY: _____ DATE: _____

TITLE: _____

FT. INDEPENDENCE PAIUTE TRIBE

BY: _____ DATE: _____

TITLE: _____

TIMBISHA SHOSHONE TRIBE

BY: _____ DATE: _____

TITLE: _____

LONE PINE PAIUTE-SHOSHONE INDIAN TRIBE

BY: _____ DATE: _____

TITLE: _____

KERN VALLEY INDIAN COMMUNITY

BY: _____ DATE: _____

TITLE: _____

Use the Bookmark Feature in Acrobat to return to Main Menu

APPENDIX E

Alternatives Analysis, Section 5 of Draft EIR

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5: ALTERNATIVES TO THE PROJECT

5.1 Introduction

5.1.1 CEQA REQUIREMENTS

Section 15126.6 of CEQA requires that an EIR describe a range of reasonable alternatives to the project that would feasibly attain the basic project objectives and avoid or substantially lessen any significant effects of the project. Alternatives may be eliminated from detailed analysis in the EIR if they fail to meet the most basic of project objectives, are determined to be infeasible, or cannot be demonstrated to avoid or lessen significant environmental impacts.

5.1.2 PROJECT OBJECTIVE

The Coso Operating Company, LLC (COC) is seeking a 30-year Conditional Use Permit (CUP No. 2007-03) from the Inyo County Planning Commission for the Coso Hay Ranch Water Extraction and Delivery System project.

The proposed project includes extracting groundwater from two existing wells on the Coso Hay Ranch, LLC property (Hay Ranch) in Rose Valley and delivering the water to the injection distribution system at the Coso geothermal field in the northwest area of the China Lake Naval Air Weapons Station (CLNAWS).

The objective of the proposed project is to provide supplemental injection water to the Coso geothermal field to minimize the annual decline in reservoir productivity due to evaporation of geothermal fluids from power plant cooling towers. The project objective is to sustain the production capacity and useful economic lives of the existing power plant units.

5.2 Alternatives Considered but Rejected

5.2.1 OVERVIEW

Section 15126.6(c) of the CEQA Guidelines permits the elimination of an alternative from detailed consideration due to:

- Failure to meet most of the basic project objectives
- Infeasibility
- Inability to avoid significant environmental impacts

Section 15126(f)(1) of the CEQA Guidelines states that "Among the factors that may be taken into account when addressing the feasibility of alternatives are site suitability, economic viability, availability of infrastructure, general plan consistency, other plans or regulatory limitations, jurisdictional boundaries...and whether the proponent can reasonably acquire control or otherwise have access to the alternative site. No one of these factors establishes a fixed limit on the scope of reasonable alternatives."

Alternatives such as evaluating different geothermal technologies or electricity generation facilities do not meet the project's basic objective of maximizing utilization of the generating capacity of the existing plants. These sorts of alternatives are uneconomical and result in stranded investment costs from decommissioning existing operational facilities. These options may also have new environmental impacts from construction, regulatory limitations, issues with available infrastructure, etc.

Alternatives such as intentionally reducing electrical generation at the Coso geothermal plants do not meet the basic project objective of maximizing utilization of the generating capacity of the existing plants and would conflict with the applicant's obligations under existing power purchase agreements. Therefore, any alternatives associated with using different technology for electricity generation or for intentionally reducing power generation at the plants were rejected for failure to meet the most basic of project objectives, lack of economic viability, and regulatory limitations in terms of violating existing power purchase agreements.

Other alternatives considered but rejected include increasing power generation through power plant enhancements and providing water through an alternative source. These alternatives and reasons for rejection are described in greater detail in the following sections.

5.2.2 INCREASE POWER GENERATION THROUGH POWER PLANT ENHANCEMENTS

Introduction

One alternative considered was the potential for increasing power generation output through power plant enhancements. This alternative has the potential to achieve the project objective of increased power generation. The feasibility of improved power generation was investigated by comparing possible increased output from various potential plant efficiency improvements to the cost of the improvements for improved power generation and to the cost from projected decrease in steam production declines related to the project.

The incremental additional power generation output associated with the project based on reservoir projections was provided by COC. The projections are based on a reservoir simulation performed by COC. Reservoir projections include the projected total mass flow produced to the power plants, the total mass injected, and the enthalpy (thermodynamic potential or heat content) of fluid produced to the power plants without the project and with the project.

The analysis was based on production rates and enthalpies forecast through 2035 for the Coso geothermal projects, with and without additional injection. The approximate additional output associated with the additional flow rates and associated different enthalpy during the period was calculated (Global Power Solutions 2008) based on these forecasts. This amount of additional output relative to the total project price of $13.4 million produces an average of nearly 18 MW (see

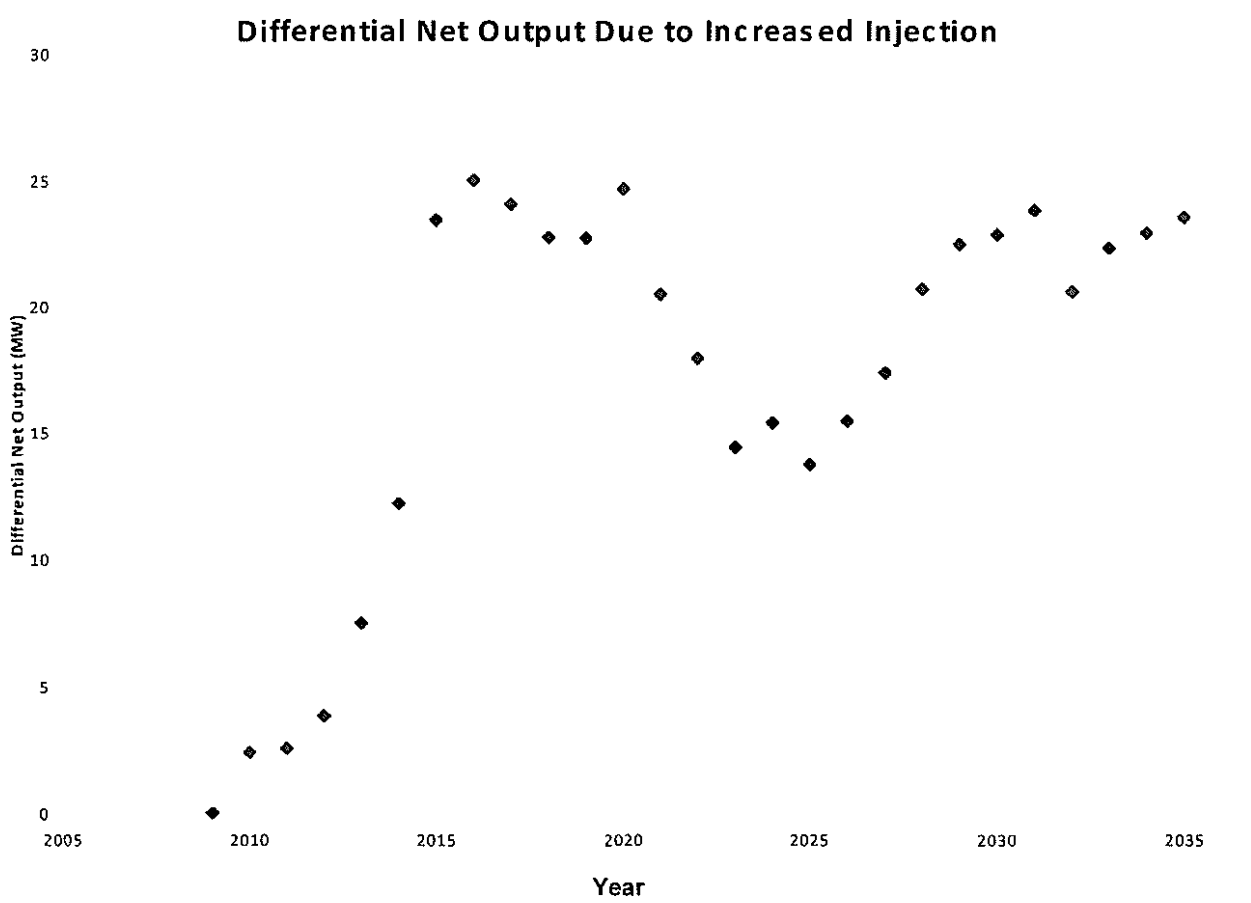
Figure 5.2-1 below) of additional output, or a cost of less than $750/kW. All other possible power generation improvements were then compared to this value.

Overall Objective

COC seeks to offset a substantial decline in the geothermal field's productivity, and the consequential reduction in power output. Early in the history of geothermal development at the Coso geothermal field, generation was approximately 270 MW. Output is now under 200 MW, representing a total power generation decline of more than 25 percent. The total mass fluid produced has declined from 15,000 kilograms per hour (kph) to approximately 9,000 kph, representing a decline of approximately 40 percent. The power generation has declined at a lower rate than the reservoir production partly because the enthalpy of the fluid has increased, but primarily because COC has already performed numerous modifications to the power generation facilities in order to increase power generation efficiency.

Most plant modifications, at best, yield benefits on the order of 5 percent and most of these have already been undertaken by COC. With the diminishing returns associated with progressively smaller modifications, plant modifications tend to become less and less economical. A combination of many smaller modifications cannot provide the magnitude of increase in productivity sought by implementing the proposed project. Plant modifications were therefore considered but rejected as part of the alternatives analysis. Additional detail on these modifications is presented below.

Figure 5.2-1: Differential Net Output Due to Increased Injection Through 2035



Previous Power Plant Modifications

COC has undertaken a series of plant modification projects over the past 20 years. These included:

- Steam gathering system modifications to reduce pressure losses
- Upgrades to the gas removal and gas treatment systems
- Turbine upgrades through reblading to improve the match between declining inlet pressure (as a result of reducing reservoir pressure) and turbine design
- Relocation of injection to optimize heat mining

Additionally, COC drilled more than 100 production and injection wells, effectively saturating the reservoir development with minimal well spacing.

Contemplated Power Plant Modifications

Overview

COC has considered several power plant modifications that were ultimately rejected due to poor economic returns. Three classes of contemplated modifications have been investigated:

1) Modifications providing additional output without utilizing more resource or system efficiency improvements
2) Modifications providing water savings through a reduction in the evaporative water losses associated with the cooling towers
3) Other sources of water for injection

Based on experience at other geothermal and non-geothermal power projects, this list appears to include all reasonable power plant modifications.

COC's System Efficiency Improvements

Most of COC's modifications to date are modifications providing additional output without utilizing more resource or system efficiency improvements. COC anticipates a continuing program of upgrades to the gas removal systems and turbine reblading to maintain the match between design inlet pressures and the reduction of reservoir pressures. These upgrades will provide benefits irrespective of augmented injection. These upgrades will be undertaken when it is economical to do so and are therefore complimentary. These improvements, however, do not match the magnitude of benefits associated with augmented injection as specified in the project objectives.

There are no known improvements that would provide a total of 18 MW of average power increase at or below $1,500/kW, twice the cost of the project. All conceivable options considered complimentary and in aggregate (combined with the project) would not bring output at Coso up to its original design output.

Examples of efficiency improvement options considered and their costs are shown in Table 5.2-1.

Water Savings Modifications

COC evaluated substitution of some or all "dry cooling" for the evaporative losses of their current wet cooling systems. These modifications are very capital intensive and result in a loss of net generated power for their water savings. The water savings, if reinjected, would not offset the power loss.

Table 5.2-1: Examples of Power Plant Efficiency Improvements

Modification	Improvement	Cost
Complete turbine replacement	~3% (1 MW/unit)	$10-15 million/unit
Binary bottoming cycle	Marginal, silica scaling potential	$1,500/kW
Noncondensable gas systems	< 1 MW/unit (4 unit potential)	Minimal
Gas precoolers	< 1 MW (6 unit potential)	$1 million/unit

Summary

None of the system efficiency alternatives are competitive with the proposed water augmentation project. Efficiency alternatives appearing to be economical in the future, including upgrades to the gas removal systems and turbine reblading, are complementary to the proposed action but would not meet the project objectives by themselves. None appear to enhance the benefit provided by injection in any material way, but may be affected in timing (as to when they become cost effective) by injection.

5.2.3 ALTERNATIVE SOURCES OF INJECTION WATER

A second alternative to the project involves obtaining water for injection from a source other than at Hay Ranch. Several alternative sources of water were identified and considered by COC as sources of injection water. These alternatives are compared with the potential productivity of the Hay Ranch wells in Rose Valley, which is approximately 3,000 gpm on average. The cost for water extraction and transfer from the Hay Ranch location is approximately $13.4 million. The cost of water delivery to the injection system would include well drilling costs, pipeline construction, pumping requirements, and environmental costs. Approximately $7.4 million is fixed, and $6 million is specifically related to the 9-mile pipeline and pumps for the Hay Ranch wells. The fixed costs include enhancement of injection systems, engineering, and permitting that would be required regardless of the location of the water, although the costs might be somewhat less for smaller amounts of water. Any alternative source of water would have to produce a significant amount of water to be economically feasible.

Possible alternative sources identified by COC (Arruda pers. comm. 2007) include:

- Groundwater wells on CLNAWS typically drilled as exploration wells
- Groundwater wells in the Coso Basin
- Marginal geothermal wells in the Coso Range

The alternative sources of water are summarized below in Table 5.2-2.

COC estimated that a water source would have to produce at least 500 gpm to be economically feasible as an injection water source. The rate is reasonable considering the fixed costs for a water extraction project are probably on the order of $7 million. None of the other considered water sources come near to those potential rates except possibly the marginal geothermal wells. The project benefit in reduction in the rate of decline of steam delivered to the power plants is based on a reduction in the current negative net mass withdrawal. Extraction of fluid from geothermal wells that are closely connected to the reservoir would not provide the reduction in net mass withdrawal that the project requires for the anticipated benefit.

The review of potential production wells does not identify any other water sources that come near to the potential to supply injection water as the Hay Ranch project at 3,000 gpm, or the minimum economically feasible amount of 500 gpm, except possibly the Coso Ranch wells. Average well

Table 5.2-2: Potential Alternative Sources of Water for Injection

Well	Location	Type	Potential Productivity (gpm)	Comments
OB1	T22SR39E Sec16	Coso Basin groundwater	<50 gpm	Potential low, based on proximity to OB2
OB2	T22SR39E Sec16	Coso Basin groundwater	<50 gpm	Pump test performed, well capable of low rate
LEGO	T22SR38E Sec16	Navy exploration well	<25 gpm	Pump test performed, well capable of low rate
G-36	T22SR38E Sec17	Navy exploration well	<25 gpm	Potential low based on location near to LEGO and surface geology
73-21	T22SR39E Sec21	Marginal geothermal well	NA	Pressure and Temp indicate well connected to Reservoir
48-11	T22SR38E Sec11	Marginal geothermal well	NA	Pressure and Temp indicate well connected to Reservoir, low permeability
CGEH	T22SR39E Sec6	Navy exploration well	<100 gpm (est.)	Low permeability in open hole section, pressure data suggests well connected to Reservoir
18-28	T22SR38E Sec28	Navy exploration well	<150 gpm (est.)	Navy test well, flow estimate based on driller information.
Coso Ranch	N/A	Rose Valley water well	N/A	Requires pipeline construction underneath a major highway. Environmental impacts more adverse than existing Hay Ranch project based on location within the valley and disturbance from the road crossing. Water would be withdrawn from the Rose Valley, similar to the proposed project. Impacts to groundwater in Rose Valley would be similar.

flow rates in the Coso Basin area are low, so it is unlikely that new wells drilled in that area would produce water at economically feasible rates.

Although the Coso Ranch wells may produce sufficient volume, the location of these wells is such that the environmental impacts (related to hydrological impacts and surface disturbance of crossing a major highway) would exceed those of the proposed project. Therefore, development of alternative sources of water does not appear to be a viable alternative to water extraction at Hay Ranch.

5.2.4 REDUCING THE TIMEFRAME OF THE CUP

Shortening the length of the Conditional Use Permit (CUP) for the proposed project was considered but rejected. Initial reasoning for shortening the length of the CUP was to link the permit to the most conservative timeframe for when the surface waters of Little Lake would not be adversely affected by groundwater drawdown. The groundwater impact modeling showed that groundwater drawdown without mitigation could impact Little Lake in fewer than 10 years. It is not

possible to define a shortened timeframe that would still prove economical and practical compared with the price of the project construction.

5.3 No Project Alternative

Section 15126.6(e) of the CEQA Guidelines requires consideration of the environmental consequences if the project is not constructed. The No Project Alternative would result in no injection of supplemental waters to the Coso Geothermal Field. The No Project Alternative would avoid any direct impacts associated with the proposed project.

The No Project Alternative would result in a shortened lifespan of the Coso geothermal projects. The Coso Hot Springs could return to a natural state sooner if the power plants and geothermal withdrawal were to cease. Other impacts associated with the plants would also cease sooner than planned (e.g. air emissions, traffic issues, etc.). If the lives of the geothermal projects are shortened, however, there would be a decrease in power supply, which would impact regional utilities or could require construction of new facilities that could have other environmental effects. The loss of the geothermal projects would also reduce royalty revenue to the federal government and Inyo County, and property tax revenue to Inyo County.

The No Project Alternative avoids potentially significant and mitigable environmental impacts identified in Section 3 Environmental Impact Analyses; however, it would not meet the project objectives of providing supplemental injection water to the Coso geothermal field to minimize the annual decline in reservoir productivity.

5.4 Considered Action Alternatives

5.4.1. ALTERNATIVE 1: PUMPING HAY RANCH WELLS AT THE MAXIMUM RATE SUSTAINABLE FOR THE 30 YEAR PROJECT LIFE WITHOUT REACHING TRIGGER LEVELS

Overview of Alternative

This alternative includes pumping of the Hay Ranch wells at estimated minimum rates that can be sustained for the entire 30 year project life without exceeding the hydrologic trigger levels identified for Little Lake Ranch. In order to not exceed hydrologic trigger levels, project pumping shall not:

- Reduce groundwater flow into Little Lake by more than 10%
- Decrease groundwater levels at the northern end of Little Lake by more than 0.3 feet

Because drawdown predicted by the numerical groundwater flow model discussed in Appendix C2 is sensitive to aquifer specific yield, which could not be determined during the preparation of the EIR, analyses were conducted to evaluate the minimum sustainable pumping rates for assumed specific yield values of 10%, 20%, and 30%.

Environmental Effects of Alternative 1

The environmental effects of Alternative 1 would be largely the same in nature as the proposed action, but would take longer to occur. The alternative would reduce but not eliminate hydrological and biological effects from groundwater pumping.

The effects to Agricultural Resources, Cultural Resources, Population and Housing, Land Use, Aesthetics, Hazards and Hazardous Materials, Air Quality, Transportation and Traffic, Noise,

Public Services, Population and Housing, and Land Use would be the same as for the proposed project. The following discussion identifies environmental effects of Alternative 1 that would differ from the effects identified for the proposed project. All mitigation measures identified for the proposed project would apply to Alternative 1 and be included in the alternative project.

Hydrology and Water Quality. This project development alternative was evaluated by constructing groundwater model scenarios in which the calibrated model parameter set and boundary conditions were held fixed with one exception: specific yield was varied from a low of 10% to the estimated average value of 20%, and to a high of 30%. Trigger levels in groundwater wells throughout the valley for the reduced pumping rate alternative would be the same as for the proposed project (Table 3.2-7); however, the elapsed time expected without exceeding a trigger level would be extended further into the future, due to the lower pumping rate.

Simulations were conducted for each of the three specific yield values to evaluate the pumping rate associated with each specific yield value that could be sustained for the entire 30 year project life without exceeding hydrologic trigger levels near Little Lake. The results of these model simulations indicated that lower pumping rates can be sustained when a low specific yield (10%) is assumed for the aquifer; higher pumping rates can be sustained when a high specific yield (30%) is assumed for the aquifer. Drawdown takes longer to develop farther from Hay Ranch (as discussed in section 3.2 Hydrology and Water Quality). The maximum groundwater table drawdown predicted to develop near Little Lake occurs years after the end of the 30 year project. For this reason, the simulation scenarios were extended to simulate groundwater conditions up to 150 years after project startup.

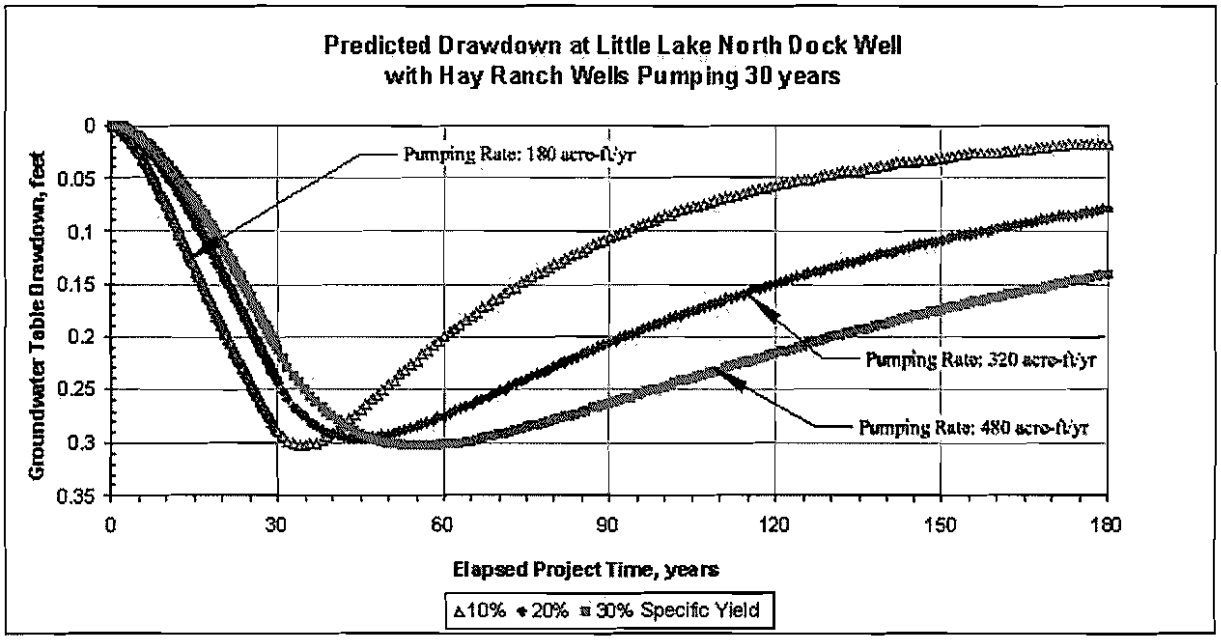
The effects of pumping at Hay Ranch for the three specific yield values on the estimated maximum pumping rate that can be sustained for the entire 30 year project life, and not exceed the hydrologic trigger levels identified for Little Lake Ranch, are shown in Figure 5.4-1. The predicted sustainable pumping rates range from approximately 180 acre-ft/yr, assuming a low specific yield of 10%, to 480 acre-ft/yr year, assuming a high specific yield of 30%. As depicted in Figure 5.4-1, the time at which the maximum drawdown is predicted to develop at Little Lake is approximately 35 years from project commencement for 10% specific yield to nearly 55 years for 30% specific yield. The groundwater table begins to rise back to predevelopment conditions after pumping is stopped at Hay Ranch; but, there is a lag time until the water levels begin to rise the farther the distance from Hay Ranch.

The model indicates that drawdown at the south end of Little Lake Ranch would be less than at the north end. Groundwater levels at the north end of the lake are the more sensitive indicators of potential impacts. The modeling analysis predicts that pumping for 30 years at the lower rates identified above (180 to 480 acre-ft/yr depending on specific yield) would not exceed the trigger levels; however, if it did, the same mitigation as prescribed for the proposed project (Hydrology-1, Hydrology-2, Hydrology-3, and Hydrology-4) would be implemented.

Geology, Soils, and Seismicity. The effects to geology and soils from Alternative 1 would be similar to those of the proposed project, with the exception that the potential for subsidence in the Rose Valley would be reduced. Subsidence would be reduced because the lower pumping rates would create less groundwater table drawdown, reducing the effects of dewatering on potentially compressible soils.

The potential for ground subsidence from the proposed project would be less than significant because of the highly consolidated nature of the soils (refer to Section 3.3 Geology and Soils). Potential for subsidence from Alternative 1 would also be considered less than significant, as pumping rates would be lower than the proposed project.

Figure 5.4-1: Hay Ranch Pumping Rates That Can be Sustained for 30 Year Project Life



Biological Resources. Effects of project construction, operation and maintenance, and decommissioning under Alternative 1 would be similar to the proposed project, except with respect to indirect impacts to water dependent vegetation at Little Lake as they pertain to impacts to the water discharge level at Little Lake. Alternative 1 would likely maintain adequate water availability at Little Lake (no greater than 10% reduction in flow into the lake and ponds). There may also be some reduction in groundwater elevation near Little Lake; however, the predicted amount of drawdown ranges from less than to only slightly greater than natural groundwater table fluctuations observed in the area. Existing plant communities are likely already adapted to groundwater table decreases of this magnitude and would not likely be impacted significantly.

Monitoring and mitigation would be the same as for the proposed project, as would trigger levels and mitigation. If the hydrologic trigger levels were reached, mitigation that requires scaling back pumping (or turning off pumping as is the case in this alternative) would be implemented.

5.4.2 ALTERNATIVE 2: PUMPING HAY RANCH WELLS AT LOWER RATES

Overview of Alternative

Several alternatives to the full project development were evaluated and consisted of pumping the Hay Ranch wells at rates and pumping durations less than the full development rate of 4,839 acre-ft/yr. Project development alternatives were evaluated by constructing groundwater model scenarios in which the calibrated model parameter set and boundary conditions were held fixed. Specific yield was set to a conservatively low value of 10 percent for these analyses. Three scenarios corresponding to Hay Ranch extraction rates of 750, 1,500, and 3,000, acre-ft/yr were conducted. The results of these modeled scenarios were evaluated in terms of the predicted impact to groundwater elevations at Little Lake and the groundwater flow rate available for discharge to Little Lake.

Environmental Effects of Alternative 2

The environmental effects of Alternative 2 would be largely the same as the proposed action and Alternative 1. The alternative would reduce, but not eliminate, hydrological and biological effects from groundwater pumping. Alternative 2 would reduce any potential for subsidence in Rose Valley due to groundwater pumping.

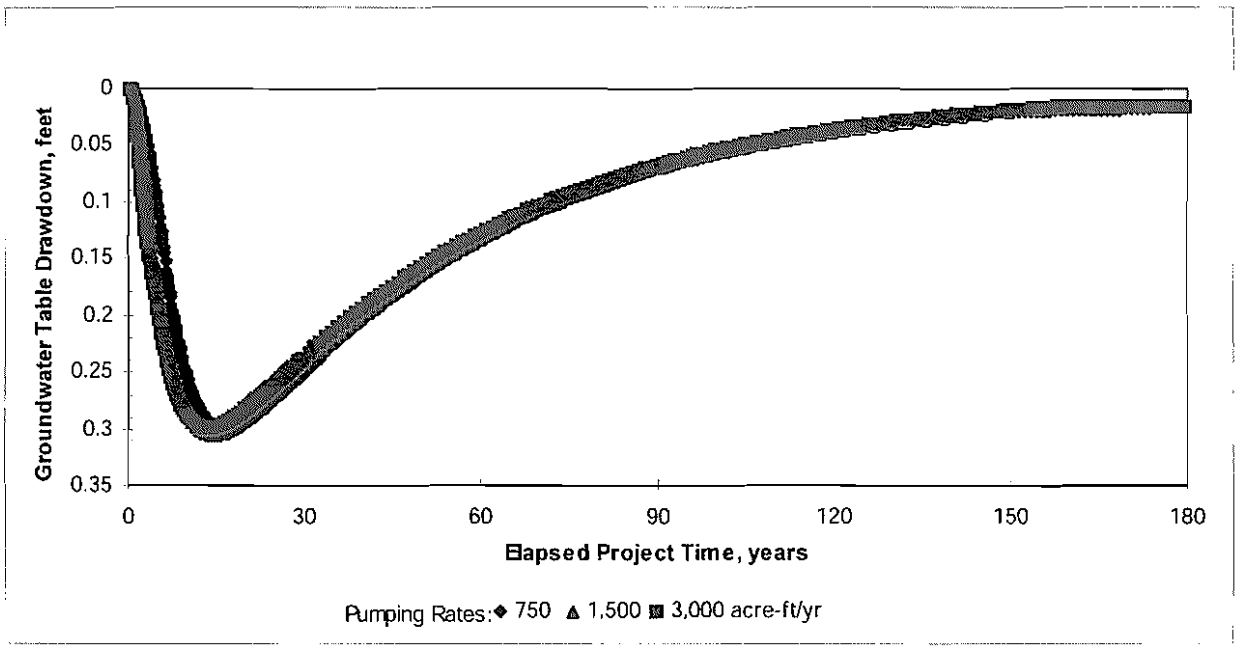
The effects to Agricultural Resources, Cultural Resources, Population and Housing, Land Use, Aesthetics, Hazards and Hazardous Materials, Air Quality, Transportation and Traffic, Noise, Public Services, Population and Housing, and Land Use would be the same as for the proposed project. The following discussion identifies environmental effects of Alternative 2 that would differ from the effects identified for the proposed project. All mitigation measures identified for the proposed project would apply to Alternative 2 and be included in the alternative project.

Hydrology and Water Quality. The effect of alternative project pumping rates at Hay Ranch on the predicted groundwater table drawdown at the north end of Little Lake is shown on Figure 5.4-2, assuming a specific yield of 10%. To avoid causing a greater than 10% reduction in flows into Little Lake, the duration of pumping was found to vary depending on pumping rate.

Based on these analyses, pumping at a rate of 750 acre-ft/yr could be sustained for at least 6 years without exceeding the drawdown trigger levels, pumping at a rate of 1,500 acre-ft/yr could be sustained for just over 3 years without exceeding the trigger levels, and pumping at a rate of 3,000 acre-ft/yr may be sustained for approximately 1.75 years without exceeding the trigger levels throughout the valley.

In the event that post-startup monitoring and subsequent numerical model recalibration indicates less drawdown propagation than indicated by this conservative analysis, pumping may be extended for this alternative similar to the proposed project.

Figure 5.4-2: Model Predicted Drawdown at North End of Little Lake for Alternative Development Scenarios



*Predicted minimum sustainable pumping durations:

- 6 years at 750 acre-ft/yr
- 3 years at 1,500 acre-ft/yr
- 1.75 years at 3,000 acre-ft/yr

Effects to hydrology from Alternative 2 would be similar in scope but of lower magnitude than for the proposed project. Less drawdown would be induced near Little Lake. The time frame for impacts to the Little Lake area would be extended slightly (see Figure 5.4-2); that is, the predicted reduction in groundwater flow towards Little Lake would occur later in the project at reduced pumping rates. However, reduction in lake discharge rates would likely still occur even at the lowest alternative pumping rate considered. Mitigation would be similar to the proposed project in that pumping should be reevaluated after the first year and the continued duration of pumping and pumping rate should be determined based on additional information collected in the first two years of pumping. If lower rates are pumped initially, pumping may be able to continue for a longer period of time than if the full pumping rate is instituted from the start. The effects would be the same as for the proposed project.

With respect to water quality, the proposed project is not expected to adversely impact water quality. Consequently, Alternative 2 would have even less potential for adverse impacts to water quality.

Geology, Soils, and Seismicity. The effects to geology and soils from Alternative 2 would be similar to those of the proposed project, with the exception that the potential for subsidence in the Rose Valley would be reduced. Subsidence would be reduced because of a lower rate of groundwater pumping at Hay Ranch.

The potential for ground subsidence from the proposed project would be less than significant because of the highly consolidated nature of the soils (refer to Section 3.3 Geology and Soils). Potential for subsidence from Alternative 2 would also be considered less than significant, as pumping rates would be lower than the proposed project.

Biological Resources. Effects of project construction, operation and maintenance, and decommissioning under Alternative 2 would be similar to the proposed project, except with respect to indirect impacts to water dependent vegetation at Little Lake. Alternative 2 would eventually cause a reduction in groundwater supply and subsequent surface water volume at Little Lake. This drawdown of groundwater levels would affect the vegetation, as described for the proposed project. Under Alternative 2, mitigation defined for hydrologic impacts at Little Lake would still likely need to be implemented, but the time at which it would be needed would be later than under the proposed project. Monitoring and mitigation would be the same as for the proposed project, as would trigger levels and mitigation.

5.5 Environmentally Superior Alternative

Section 15126.6(e)(2) of the CEQA Guidelines stipulates that "If the environmentally superior alternative is the No Project alternative, the EIR shall also identify an environmentally superior alternative among the alternatives."

The No Project alternative would maintain the existing groundwater conditions in Rose Valley but result in continued decline of the geothermal reservoir at the Coso geothermal field and the resultant decreases in productivity of the power plant facilities. The early decommissioning of the Coso geothermal plants would result in the need for construction of new power generation facilities elsewhere to make up for the loss of the over 200 MW of power supplied by the Coso geothermal projects. Construction of new power facilities could have associated environmental impacts related to construction and operation, the impact of which are speculative at this time due to several unknowns, such as what type of plants would be affected, and their locations. While the No Project Alternative would avoid groundwater impacts to the Rose Valley, the effects to electric supply in the region and the associated environmental effects of generating new electricity to compensate for the electricity lost from the Coso projects could be greater. The No Project Alternative would

also result in a return of the Coso Hot Springs to natural conditions. The proposed project and Alternative 1 and 2 may actually return conditions sooner since additional water would be added to the reservoir reducing the steam cap (see section 3.2 Hydrology and Water Quality) upon project implementation.

The proposed project, without mitigation, would result in several potentially significant impacts. All potentially significant impacts could be mitigated to less-than-significant levels with implementation of mitigation measures outlined in this EIR. Alternative 1 would not reach groundwater drawdown trigger levels at Little Lake; however, neither would the proposed project or Alternative 2 if mitigation is implemented. These three alternatives would likely have equal environmental effects, but the timing for pumping and the length of time over which effects are felt would differ.

APPENDIX G
Revegetation Plan

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1988 REVEGETATION PLAN FOR THE CHINA LAKE JOINT VENTURE GEOTHERMAL DEVELOPMENT

COSO KNOWN GEOTHERMAL RESOURCES AREA

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June 28, 1988

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PREFACE

Several factors should be considered when planning revegetation at the Coso Known Geothermal Resource Area:

1. Growth of desert plants is slow even under the most favorable conditions, and revegetation will also be slow.

2. Weather is the single most influential factor, and its extreme variability confounds revegetation planning and brings mixed results.

3. Wind and dryness are the enemies of revegetation; both are present in quantity at Coso.

4. Artificially augmented plant growth brings on additional risk: watering and fertilization enhance leaf growth which can be suppported only by continued regular care for an indefinite period of time. Also, both watering and fertilization increase plant palatability to herbivores.

5. The remoteness of the Coso site makes intensive maintenance of a revegetation program difficult, although regular review of progress is required.

6. The continued presence of burros and cattle reduces the likelihood of success of a revegetation program.

These factors suggest that the most successful revegetation plan is one which relies primarily on natural processes and requires little intervention once site preparation is complete.

In order of priority, the two principal objectives of pre-abandonment revegetation at Coso are erosion control and the use of indigenous native plant species to help compensate for lost habitat for the threatened Mohave ground squirrel (*Spermophilus mohavensis*). These objectives can be accommodated concurrently, with the greater emphasis on erosion control in the initial stages.

The revegetation program outlined here calls for clearly-defined objectives, good site preparation, use of native seed, limited followup care and periodic monitoring.

INTRODUCTION

Geothermal development at the Coso Known Geothermal Resource Area (KGRA) by the China Lake Joint Venture (CLJV) involves the commitment of land for roads, pipelines, wellpads, power plants and transmission facilities. Most of the land is committed for the life of the project, but an estimated 5 percent consists of temporary use areas and cut and fill slopes. Treatment of these lands, present and future, is the subject of this plan. At this time, one power plant and 25 wellpads have been constructed; an additional power plant site and two wellpads are presently under construction; and two additional power plants and a number of wellpads are planned. This plan addresses the specific treatment of each existing facility, and sets forth procedures for in-progress and future work.

CLJV is presently operating under permit conditions requiring revegetation of unvegetated cut and fill slopes, stockpiling topsoil, use of indigenous plant species in revegetation, and whatever additional measures are required by the China Lake Naval Weapons Center (NWC) and Bureau of Land Management (BLM) to satisfactorily control erosion. In addition, the California Department of Fish and Game (CDFG) must approve of elements of the revegetation plan which affect wildlife habitat. This revegetation plan primarily addresses the use of plant material, and includes procedures for grading and maintenance of existing and future cut and fill slopes as these practices relate to revegetation.

Loss of wildlife habitat is the principal impact to biological resources from the Coso development, and of particular concern is the loss of habitat for the state-listed threatened Mohave ground squirrel (*Spermophilus mohavensis*). Information is presently being developed on the habitat requirements of this species as part of other mitigation measures on CLJV projects. The use of suitable plant materials in revegetation can help to compensate for, and in part replace, lost habitat for the Mohave ground squirrel.

Abandonment is not addresssed in this plan, since virtually no land is considered by CLJV to be abandoned at this time. The site-specific experience derived from revegetation efforts now will set the stage for effective revegetation when more extensive areas will be reclaimed upon abandonment.

OBJECTIVES

This plan is designed to meet two objectives: first and foremost, erosion control; second, the establishment of indigenous vegetation resembling that of the nearby landscape, with a priority on the use of plant materials having habitat value for the Mohave ground squirrel.

METHODS

Information on previous work on revegetation in the Mohave Desert was reviewed. Published material included reports prepared by the University of California Cooperative Extension, the U.S. Soil Conservation Service (SCS), and the California Department of Transportation, as well as proceedings from recent revegetation symposia. Knowledgeable individuals were also contacted by telephone to obtain additional information. Burgess L. (Bud) Kay, an authority on Mohave Desert revegetation, conducted a preliminary site visit in December, 1987. Drafts of this plan were reviewed by California Energy Company (Cal Energy, the operator for CLJV), NWC, BLM, and CDFG.

DESCRIPTION OF THE REVEGETATION SITE

The CLJV geothermal development is located at 3000 to 4500 feet elevation in the Coso Range, China Lake Naval Weapons Center, Inyo County, California. Summers are hot and winters are cold. Freezing temperatures may be expected from at least November through March. Mean monthly temperatures range from about 40 degrees F (December) to about 85 degrees F (July-August). The area is subject to strong winds throughout the year.

Annual precipitation ranges from 3 to 6.5 inches (Environmental Monitoring and Services Center, 1980). Most precipitation falls in the winter. Occasional summer thundershowers take place in July and August; although sporadic, these storm events may have a significant influence on revegetation efforts. They provide important moisture during the critical summer months, but their intensity also presents potential for erosion caused by runoff.

Although the area has a complex geologic history, much of the present and proposed development is on recent volcanic formations. Slopes are gentle to rather steep (0 to 30 percent slopes in most developed areas). The soils are formed over welded tuff, or over sediments derived from tuff. Maynard Lake coarse sands predominate; coarse-textured sands are found on sideslopes and fine-textured material in alluvial basins. Coso-Rock Outcrop stony sandy loams are found on the higher slopes and upper basins (WESCO 1980).

The botanical features present include three natural communities: Mohave creosote bush scrub, Mohave mixed woody scrub; and desert saltbush scrub (Holland 1986). No rare and endangered plants are known to occur in the area presently being developed. The NWC resource staff have identified the Joshua tree (Yucca brevifolia) and the cottontop cactus (Echinocactus polycephalus) as plant species of special management concern within the KGRA. Transplanting of young, healthy Joshua trees

within the subject operating area is recommended when practical to reduce project impacts (Leitner and Leitner 1987). This action appears as an approval condition attached to specific project permits, as appropriate. Salvage of the cottontop cactus may be carried out at the discretion of NWC.

THE REVEGETATION PROCESS

Certain aspects of the revegetation process are common to all sites:

1) A site evaluation is carried out to identify site condition and needs for revegetation and erosion control;

2) Revegetation procedures are developed, consisting of a site-by-site description of work needed;

3) In areas such as Coso where revegetation efforts are relatively new, testing of treatments helps to determine the most effective approach for the site conditions. Testing at this stage of the revegetation process is important for developing procedures that will be used more extensively during the abandonment phase.

4) Implementation is carried out by qualified contractors.

5) Monitoring is needed to assure that objectives have been met.

6) Review, evaluation and planning are carried out regularly to determine the effectiveness of various methods and to plan for future revegetation.

THE REVEGETATION PLAN

The revegetation plan presented here will proceed according to the steps outlined in the section above. What follows is a description of standard procedures. Some are common to all revegetation sites. Where a choice of treatment is available, the criteria for the selection of a treatment is given. Specific actions are outlined in Appendix I for each of 25 already-constructed wellpads; the Navy 1 power plant and fill disposal areas; and all future and under-construction wellpads. Appendix II presents a more detailed discussion of revegetation practices reviewed for their applicability at the Coso site.

1. Site Evaluation

A preliminary site evaluation was carried out in December, 1987 to assess revegetation needs and the feasibility of using various techniques. A preliminary plan was reviewed by Cal Energy, NWC, and BLM; this plan incorporates their comments.

Further evaluation will be carried out to develop a baseline on physical conditions at revegetation sites. Soils from representative sites will be collected and sent to SCS or a private laboratory for analysis of soil texture, water-holding capability, and available nitrogen, phosphorus, and potassium. These samples will be taken from wellpads 54-7, 72-18, 51-17, 64-18 (Navy 2 pad R), and BLM 1 Pad A to document typical conditions. Most pads are constructed on sites within the Maynard Lake soils mapping unit and are expected to be similar in their chemical and physical properties. More samples will be taken from additional sites if a wide variation in soil conditions is evident from this initial sampling. To assess potential low fertility soil conditions, soil samples will be taken from wellpads 75-7, 41-8, 73-19, 72-19 and 24-20. The angle and condition of each cut and fill slope will be documented and incorporated into a site-specific data base to be maintained on each revegetated site.

2. Revegetation Procedures

Short-term erosion control and long-term erosion control and revegetation needs must be addressed for all unvegetated sites. The present degree of erosion hazard and natural revegetation will dictate the emphasis placed on each. Slopes with little erosion hazard and some natural revegetation will require the least treatment; newly-graded slopes or existing slopes with rill and gully erosion, a history of frequent maintenance, or evidence of low-fertility soils will require the most intensive treatment.

The standard approach here to short-term erosion control is broadcasting barley seed. Barley is quick to form a dense, shallow root system to hold the soil, but is non-persisting in the desert and thus does not compete with native species after the first year. If a high erosion hazard exists, a dense seeding of barley is applied the first year. Long-term erosion control and revegetation is not attempted until slope stability is improved. On existing slopes not already treated for revegetation, barley will be applied in the fall (late October to early November) just before the onset of winter rains. Barley should be applied to newly completed slopes within 24 hours of final grading to allow loose soil to cover the seed. No watering is required.

Long-term erosion control and revegetation is approached through the use of indigenous plant materials. Seeding with perennial shrubs is the main element, although some native perennial grass seed will be included as well (see "Choice of plant materials" below). Sites with some natural revegetation and/or low erosion hazard will be spot seeded, a hand application measure described by Chan et al. (1977). In this treatment, a few seeds are placed into a hand-excavated shallow pit, and

covered by a small amount of soil. Spot seeding can be done in any density specified; the recommended density here is on 6 foot centers. The procedure will be carried out in the fall, preferably late October. No additional watering is required. Fill slopes of future pads will receive an application of conserved surface soil; an application of 4 to 6 inches is recommended. The effectiveness of surface soil alone in encouraging growth of native shrubs will be compared with surface soil spreading plus broadcast seeding (see "Testing of Treatments", below).

Dust control is an ongoing air quality issue in the Coso area, and specific measures to control fugitive dust have been taken into account when planning revegetation work. Watering during grading is required for dust control; it helps the soil to form a crust. However, a heavy application of water may stimulate germination and cause subsequent seedling mortality. As a result, seeding should be timed to closely follow these dust control measures to achieve the benefit of some blown soil to cover seed, but avoid excessive moisture. Seeding is recommended within 24 hours following final grading.

A more detailed discussion of each type of revegetation site is presented below.

Existing cut slopes. Erosion hazard on cut slopes is generally not a problem, so use of broadcast seeded barley and native seed is not planned. Cut slopes will be spot seeded with a native shrub-grass mixture. The density of planting will depend on the degree of natural revegetation already in place.

Very little active maintenance is needed for most cut slopes. Natural seedfall from undisturbed slopes above is an excellent source of seed. Alluvium collecting on the wellpad from erosion of the cut slope will be allowed to assume its natural angle of repose and will not be graded off.

Existing fill slopes. Fill slopes are more susceptible to erosion than the more compacted cut slopes, and they lack a nearby source of native seed. Consequently, fill slopes require more attention than cut slopes. The following practices will be applied to fill slopes:

- Fill slopes with pronounced rill and gully erosion (shown as a plus (+) in the erosion column of the Appendix I tables) with a history of maintenance will be seeded in the fall. The recommended application rate for erosion control is 300 lbs/ac of barley. Spot seeding with a native seed mix will be done the following fall or when the slope shows signs of improved stability. Sites with minor rill and gully erosion will be discussed with Cal Energy maintenance to ascertain the anticipated maintenance schedule; these sites may be

seeded with 300 lbs/ac barley in the fall (late October) or left until regrading, when they will be treated as for a newly-graded site.

- Fill slopes with low erosion hazard (shown as a minus (-) in Appendix I under "erosion") but having no natural revegetation (shown as a minus (-) in Appendix I under "natural revegetation") will be broadcast seeded in the fall (late October) with 100 lb/ac barley and spot seeded with a native seed mix.

- Slopes with low erosion and good natural revegetation (shown as a plus (+) in Appendix I under "Natural Revegetation") will receive no barley seeding but will be spot-seeded in late October with a native seed mix.

Standard procedures for newly graded sites. The principal short-term erosion control measure, as with older graded sites, is the use of direct-seeded barley. For long-term erosion control and revegetation, use of conserved surface soil is the most important element. Cut and fill slopes constructed in connection with wellpds, roads, power plant sites, or any other related facilities will be treated according to the following methods.

Before grading begins on a new site, the application site for conserved surface soil will be identified and a plan developed for its use. Newly graded sites will have the surface soil (no less than 2 inches and no more than 4 inches) collected for application on final-graded fill slopes. For a standard size 6 acre wellpad (including cut and fill slopes), conserved soil removed to the minimum depth of 2 inches will amount to 1,613 cubic yards of volume. If an average depth of 3 inches is taken, about 2,400 cubic yards will result.

Conserved surface soil quickly deteriorates when stockpiled, and the benefit to revegetation likewise diminishes. Collecting and applying conserved surface soil in the same operation is the least expensive method, since the soil must be loaded and unloaded only once. To assure viability of surface soil organisms, application to a completed fill slope must take place within 24 hours of initial grading during the season (November-April and within one week of any summer precipitation exceeding 0.25 inches). When soils are dry, they must be applied within 5 days of collection.

Conserved surface soil will be applied to newly completed fill slopes to a depth of 4 to 6 inches, and smoothed and compacted according to existing requirements for engineering and dust control. Maximum surface roughness will be sustained.

Standard mitigation measures for the preservation of Joshua

trees will also be observed, including avoiding surface disturbance within 50 ft of a Joshua tree whenever possible, and transplanting Joshua trees when necessary to avoid their loss.

New cut slopes will be treated as follows:

1) Where the maximum cut is 20 ft or less of depth, the angle of cut will be 2:1. Where the maximum cut exceeds 20 ft due to sloping terrain, the angle of cut will range between 2:1 and 1:1 as needed.
2) For each 10 ft of depth, a contour trench at least 6 inches in width will be constructed in the cut slope.
3) Maintain maximum surface roughness during final grading.

New fill slopes will be treated as follows:

1) Slopes will be graded as close to a 3:1 slope as possible.
2) During final grading, conserved surface soil will be applied to the slope. The recommended rate is 4 to 6 inches.
3) Maintain maximum surface roughness with tractor cleats.
4) Apply broadcast-seeded barley at 100 lb/acre as soon as possible, preferably within 24 hours of final grading and watering, and allow soil to cover.
5) If surface soil is not available, broadcast seed at 20 lb/ac with native seed mix immediately following grading or in late October.

Laydown areas. Laydown areas are considered to be areas of disturbance and must be permitted by the same procedure as wellpads. It should be noted that no laydown areas presently exist, since wellpads have been used for this purpose. Laydown areas are areas bladed to remove vegetation but the surface topography has not been altered. They generally have been compacted from the action of heavy equipment, and this compaction must be relieved to achieve good revegetation. Seeding with barley is not expected to be required, since laydown areas are generally level and do not present an erosion hazard. Treatment of laydown areas which are not expected to be re-used is as follows:

1) If creosote bush was present, harrow lightly to relieve compaction without damage to root crowns.
2) If no creosote bush, rip to a depth of 18 inches.
3) Spread surface soil to a depth of 4 to 6 inches, if available.
4) If surface soil is not available for application, broadcast seed a native seed mix at 20 lb/ac in late October.

Transmission lines. CLJV constructed the 28.5 mile 115 k/v Devil's Kitchen-Inyokern transmission line in the summer of 1986. Site inspections of the construction area in 1987 and 1988 show that natural revegetation has occurred at a fast enough rate to

stabilize soils and prevent erosion; no further actions are proposed. New transmission lines, including the 220 kV line and taps from power plants to the line, will be treated as follows:

1) Vegetation will be crushed instead of bladed at the structure sites and along spur access roads whenever topography allows. Crushing instead of blading preserves soils and seed sources on-site.
2) In areas of greater topographic relief where cut and fill slopes are required, such slopes will be treated as described above, under "Standard procedures for newly graded sites; cut and fill slopes".

Choice of plant materials. Desert saltbush (*Atriplex polycarpa*), fourwing saltbush (*A. canescens*), and buckwheat (*Eriogonum fasciculatum*) have produced good results in seeding trials carried out by the California Department of Transportation near the Coso area (Clary and Slayback 1984). Limited to poor success was obtained from cheesebush (*Hymenoclea salsola*), Mormon-tea (*Ephedra nevadensis*), creosote bush (*Larrea tridentata*), and Indian ricegrass (*Oryzopsis hymenoides*). No information on seeding trials using spiny hopsage (*Grayia spinosa*) was available, although it is a significant component of the desert scrub community in the Coso area.

On the basis of these trials, the three most successful species (which also are important components of the shrub layer in the Coso KGRA) will comprise 70 percent of the seed mix. The remaining 30 percent will be composed of species which also are important structural components of the natural communities present. Although these species may not establish themselves in high numbers, it is anticipated that at least some of them will become established.

The native seed mix is as follows (percentages are by weight):

Atriplex polycarpa	30%
Atriplex canescens	30%
Eriogonum fasciculatum	10%
Hymenoclea salsola	10%
Oryzopsis hymenoides	5%
Ephedra nevadensis	5%
Grayia spinosa	5%
Stipa speciosa	3%
Eurotia lanata	2%

This mix will be used assuming commercial availability. The recommended seeding rate is based on percent live seed. Seed will be custom collected from the vicinity of the Coso area (within 25 miles, if possible, and from an elevation range of 3000 to 4500 ft elevation). If seed production is poor for

certain species which are commercially available, a portion of the seed mix may be obtained from existing stock, provided it originated from the Mohave Desert.

Initially, this choice of seed mix is based on successful tests nearby in the Mohave Desert. It will be modified as the results of seeding tests become available for the Coso site, and as more information is collected on the habitat requirements of the Mohave ground squirrel as part of the Coso Grazing Exclosure mitigation program.

Annual forb (broadleaf) seed is not recommended for the initial stages of this revegetation program, although it might be considered at a later time. The reasons are: forbs used in initial seeding may present more competition for shrub seedlings; and the presence of forbs may attract herbivores before the shrub seedlings are able to tolerate browsing. Forb seeding will be reconsidered when the shrub layer is well established. Cal Energy will seed with forbs as directed by the agencies responsible for the Coso Mohave ground squirrel mitigation plan, since this action would be undertaken principally as a habitat enhancement action for this threatened species.

Post-treatment maintenance. This revegetation plan is designed to require a minimum of post-treatment care. The plant species selected for use are adapted to prevailing conditions. Irrigation is not planned because plants watered during their early establishment develop a root and leaf structure dependent on continued water. Kay and Graves (1983) found no benefit from irrigation when suitable species are planted in the fall or early winter and normal amounts of rainfall followed.

Re-treatment. In the event that rainfall is extremely unfavorable, retreatment similar to initial treatment will be required, including broadcast seeding and/or spot seeding. Retreatment will also be required after maintenance grading; annual inspections by Cal Energy and NWC (and BLM as appropriate) will determine the advisability of regrading slopes, taking revegetation efforts into account.

Criteria for success. As an initial standard, shrub densities on sites treated for revegetation should after 5 years support a density of shrubs equal to about 60 percent of the density found at the benchmark monitoring sites (see monitoring section). Shrub size will obviously be less on revegetation sites. If the density standard is not met, spot seeding or other measures will be repeated to achieve the desired shrub density.

3. Testing of Treatments

The most important treatments to be tested at this stage are as follows: 1) mulching with straw; 2) use of herbivore protectors; 3) use of fertilizer; and 4) broadcast seeding with a

native seed mix on newly completed slopes. Appendix I shows the experimental design of treatments. Two replicates, as similar as possible, were selected for each treatment, with the exception of straw mulch and broadcast seeding. These treatments must be applied to newly-completed slopes and replicates will be designated as they become available.

It should be noted that the monitoring program will also provide an opportunity for comparison of treatments, such as the success of the seeding mix on different slopes and exposures, the success of surface soil spreading against direct seeding, and a comparison of revegetation rates on different soil types, slopes and exposures. This type of information, while not testing in the experimental sense, will provide valuable information for future planning in revegetation.

4. Implementation

Much construction activity has been initiated in the calendar year 1988, and a large number of previously untreated slopes must be addressed. Implementation in 1988 will include:

- Evaluate soils further;
- Collect local seed;
- Engage contractor(s) to apply stockpiled surface soil, carry out broadcast seeding, spot seed, and install rodent protectors, straw mulch, and fertilizer;
- Identify a monitor for revegetation evaluation; and
- Establish an information data base on each revegetation site.

5. Monitoring

Criteria for evaluation. The monitoring phase of the revegetation program will include a comparison of revegetation sites against undisturbed sites for which vegetation characteristics are well known. The "benchmark" reference sites may consist of adjacent undisturbed vegetation, or of nearby sites which resemble the soil, slope, and exposure of the revegetation site. However, the characteristics of sites known to support high densities of Mohave ground squirrels may also be used as reference sites against which revegetation success is measured. Ultimately, success of the revegetation program is achieved when the species composition, frequency, density, cover and biomass approximates that of the benchmark reference site. An interim measure of success is to achieve within 5 years a shrub density which is 60 percent of the benchmark site.

Methods. Reference sites will be selected on the basis of the pre-existing vegetation and desired characteristics for Mohave ground squirrel habitat. One reference site may serve for several revegetation sites, if the site characteristics are

reasonably similar. The exact size and location of the reference site will be chosen in the field, but will approximate the size of a wellpad fill slope. The species composition, frequency, density and cover of benchmark reference sites will be measured. The species, size and location of the shrub layer will be mapped on 10 by 10 meter squares. Five to 10 such quadrats will be used for a reference site, depending on the variability of the site. Standing crop, species composition, and estimated cover will be measured for the herb layer using 50 square-foot plots.

Monitoring at the revegetation sites will be characterized in a similar manner. However, care must be taken in the initial years not to allow excessive foot traffic on the cut and fill slopes. Treading breaks the crust formed on the soil surface, encouraging wind and water erosion. At first, only the shrub layer will be characterized using 10 by 10 meter areas. This can be done by observers standing on the upper and lower edges of most fill slopes. Herbaceous vegetation will be noted as to species composition for each site, but intensive measurement is not recommended initially because of the erosion hazard.

Monitoring will be carried out annually at the revegetation sites. After the initial survey, the reference sites will be re-surveyed every five years until project abandonment. Productivity will be estimated from limited plant clipping, as feasible without adversely affecting the progress of the revegetation process.

Establishing a data base for revegetation efforts. Over two dozen graded sites, several soil types and exposures, and a number of experimental treatments will quickly become unwieldy to track without a systematic means of recording and updating information. A data base will be established, with the following elements:

1) A site map showing each graded site at 1:200, and a master site map showing each wellpad, by section;
2) Oblique photographs of each pad, taken every two years;
3) A record of the "as-built" areas of disturbance for each pad;
4) Information on slope, rill and gully erosion, and the physical and chemical composition of the soils, as this information is available;
5) Records of the date of pad construction, dates of any pad maintenance as it relates to revegetation efforts; and
6) A record of the date and type of revegetation treatments.

The most important aspect of monitoring is the feedback loop it provides for future planning. The relative success of various methods can be used to achieve optimum revegetation strategies for the future. As a result, the monitoring results will be written up annually and attached to the annual revegetation plan.

6. Review, Evaluation and Planning

An evaluation of revegetation actions and monitoring results will be conducted annually. Cal Energy will submit an updated revegetation plan for NWC, BLM and CDFG approval. The most useful time for a review would be in late summer or early fall, when seedling germination and establishment for the year is known, and prior to treatments required during late October.

REFERENCES CITED

Chan, Franklin J., Richard W. Harris, and Andrew Leiser. 1977. Direct seeding woody plants in the landscape. University of California Agricultural Extension Leaflet 2577. 12 pp.

Clary, Raimond F. and Richard Slayback. 1984. Revegetation in the Mojave Desert using native woody plants. In: Proceedings of the symposium on native plant revegetation, November 15, 1987, San Diego, CA. Pp. 42-47.

Environmental Monitoring and Services Center. 1980. Air quality technical report on the Coso geothermal study ara. In support of Coso geothermal development environmental statement. Bureau of Land Management, Bakersfield, CA. 173 pp.

Holland, Robert F. 1986. Preliminary descriptions of the terrestrial natural communities of California. California Department of Fish and Game, Sacramento, CA. 156 pp.

Kay, Burgess L. and Walter Graves. 1983. Revegetation and stabilization techniques for disturbed desert revegetation. Chapter 17 in Environmental effects of off-road vehicles, impacts and management in arid regions. Webb, R.H. and H.G. Wilshire (eds.) Springer-Verlag. 534 pp.

Leitner, Barbara Malloch and Philip Leitner. 1987. Report on biological resources, China Lake Joint Venture's BLM 1 field development and power plant construction program, China Lake Naval Weapons Center, California. Prepared for McClenahan and Hopkins Associates, Kensington, CA 45 pp.

WESCO. 1980. Soils technical report on the Coso geothermal area. In support of Coso geothermal development environmental statement. Bureau of Land Management, Bakersfield, CA. 256 pp.

APPENDIX I. SPECIFIC REVEGETATION ACTIONS FOR UNVEGETATED SITES

Table I-A. Navy 1 operating area erosion control and revegetation measures.

Facility	Site Conditions*					Short-term erosion control	Long-term		Test Measures					
	Surface	Exposure	Test soils	Erosion	Natural reveg.	Barley seeding (lbs/ac)	Spot seed natives	Spread surface soil	Fertilizer	Perimeter fence	Plant	protectors	Straw mulch	Brushing & minor mix
Navy 1 power plant	Cut	N		-	+		x							
	Fill	NW	+	-	+		x							
Fill disposal	Fill	N		+	-	300	x							
Wellpad 78-6	Cut	N		-	-		x			Control for				
	Fill	N		-	-	100	x			61-7,63-7				
Wellpad 52-7	Cut	SE		-	-		x			Control for				
	Fill	SE		-	-	Dec. 1987	x			54-7				
Wellpad 54-7	Cut	N		-	-		x		x					
	Fill	N	+	-	-	100	x		x					
Wellpad 61-7	Cut	N		-	-		x							
	Fill	N		-	-	100	x				x			
Wellpad 63-7	Cut	N		-	-		x							
	Fill	N		-	-	100	x					x		
Wellpad 71-7	Cut	N		-	+				Control,					
	Fill	N		-	+				no treatment					
Wellpad 73-7	Cut	N		-	-		x							
	Fill	N		-	-	100	x							
Wellpad 75-7, 76-7, 77-7, 87-7, 15-8	Cut	SW		-	-		x		Compare with					
	Fill	SW	+	+	-	300		in 1989	41-8, poor soil					
Wellpad 78-7	Cut	S		-	-		x							
	Fill	S		-	-	100	x							x
Wellpad 11-8, and 31-8	Cut	N		-	+		x							
	Fill	N		-	+		x							
Wellpad 41-8	Cut	N		-	-		x		x					
	Fill	N	+	-	-	100	x		x					
Wellpad 47-8	Cut	S		-	-		x							
	Fill	S		-	-	100	x			Compare with 78-7				
New developments	Cut						x							
	Fill					100		x		Test		x		x

*Present site conditions:
Exposure: N=north; S=south; E=east; W=west;
Test soils: "+" indicates physical and chemical testing to be done;
Erosion: "-" indicates erosion hazard not significant; "+" indicates maintenance may be required;
Natural revegetation: "+" indicates natural revegetation is evident; "-" indicates little or no natural revegetation.

Table I-B. Navy 2 wellfield and power plant erosion control and revegetation measures.

Facility*	Site Conditions*					Short-term erosion control	Long-term		Test Measures						
	Surface	Exposure	Test soils	Erosion	Natural revegetation	Barley seeding (lbs/ac)	Spot seed natives	Spread surface soil	Fertilizer	Perimeter fence	Plant protectors	Straw mulch	Erosion control	Natural revegetation
Wellpad 37-17	Cut	NE	-	-			x							
	Fill	NE	-	-		100	x							
Wellpad 63-18	Cut	S	-	-			x							
	Fill	S	-	-		100	x				x			
Wellpad O	Cut	S	-	-			x		Control,					
	Fill	S	-	-		100	x		pads P, 63-18					
Wellpad P	Cut	S	+ -	-			x							
	Fill	S	-	-		100	x			x				
Wellpad U	Cut	S	-	-			x							
(in progress)	Fill	S	-	-				x	test				x	
Wellpad R	Cut	N	+				x							
(in progress)	Fill	N				100		x						
Wellpad Y	Cut	S					x		Compare with					
(in progress)	Fill	S				100		x	Wellpad R,U					
Future developments	Cut						x							x
	Fill					100		x	test			x		

*Present site conditions:
Exposure: N=north; S=south; E=east; W=west;
Test soils: "+" indicates physical and chemical testing to be done;
Erosion: "-" indicates erosion hazard not significant; "+" indicates maintenance may be required;
Natural revegetation: "+" indicates natural revegetation is evident; "-" indicates little or no natural revegetation.

Table I-C. BLM 1 wellfield and power plant erosion control and revegetation measures.

Facility	Site Conditions*					Short-term erosion control	Long-term		Test Measures					
	Surface	Exposure	Test soils	Erosion	Natural revegetation	Barley seeding (lbs/ac)	Spot seed natives	Spread surface soil	Fertilizer	Perimeter fence	Plant protectors	Straw mulch	Broadcast mulch
Wellpad A	Cut	S	+	-	-		x		Compare with				
	Fill	S		-	-	100	x		33-19, 73-19				
Wellpad 33-19	Cut	S		-	-		x						
(=C)	Fill	S		-	+		x			x			
Wellpad 72-19	Cut	S		-	-		x						
(=D)	Fill	S	+	+	+	300	in 1989						
Wellpad 73-19	Cut	S		-	-		x						
(=E)	Fill	S	+	-	+		x				x		
Wellpad 46-19	Cut	N		-	-		x						
(=F)	Fill	N		-	+		x						
Wellpad 24-20	Cut	SE		-	-		x						
(=G)	Fill	SE	+	+	-	300	in 1989						
Wellpad P	Cut	S					x						
(in progress)	Fill	S				100		x					
Wellpad Q	Cut	E											
(in progress)	Fill	E				100		x	as feasible				
Future development	Cut						x						
	Fill					100		x	Test			x	X

*Present site conditions:
Exposure: N=north; S=south; E=east; W=west;
Test soils: "+" indicates physical and chemical testing to be done;
Erosion: "-" indicates erosion hazard not significant; "+" indicates maintenance may be required;
Natural revegetation: "+" indicates natural revegetation is evident; "-" indicates little or no natural revegetation.

APPENDIX II. DISCUSSION OF REVEGETATION PRACTICES

SITE PREPARATION

Slope

Within a given soil type, slope is a determining factor for the rate of soil erosion. Although runoff-caused erosion can occur on slopes as gentle as 20 percent (5:1) (Kay and Graves 1983a), soil erosion accelerates with increasing slope. Under experimental rainfall conditions, Kay (1984) found that gravelly sandy loam lost five times more soil from 2:1 slopes than from 5:1 slopes.

The loose soils and unconsolidated parent material at the Coso site rapidly assume their angle of repose, probably about 30 percent, as can be seen from alluvium collecting at the bases of cut slopes. The loose material is an ideal site for plant establishment. Revegetation will take place more rapidly on less steep slopes. Rill erosion is also less severe. The recommendation for future grading is to grade both cut and fill slopes at 2:1 or, preferably, 3:1 slopes whenever feasible. Determination of acceptable slopes will be made on a case-by-case basis.

Cross-drains or contour trenches on fill and cut slopes reduce sheet erosion hazards and provide more favorable sites for plant establishment while presenting little extra graded surface. They reduce the flow and force of water moving downslope, and increase infiltration (Kay and Graves 1983b). They are especially useful in arid lands, and are recommended at this site when feasible.

Surface roughness and other final grading practices. Burgess L. Kay, an authority on revegetation in the Mohave Desert, believes that encouraging natural revegetation is the most economical and effective approach in arid lands (Kay, pers comm., October, 1987). Wind is a natural seed dispersal agent, and a rough surface captures wind-blown seed. Eliminating the final smoothing of graded surfaces encourages seed capture. For slopes already smoothed, "trackwalking" will enhance the effects of natural seedfall (CARCD 1986). Compacted surfaces no longer in use should be ripped to a depth of 18 inches to relieve compaction.

Conserving surface soil. To avoid possible confusion as to whether topsoil (in the usual sense of a discernable surface layer high in organics) actually exists in the Coso region, the term surface soil will be used to refer to the uppermost 4 inches of soil.

An inexpensive source of local seed and beneficial micro-

organisms is surface soil. When surface soil is conserved at the onset of grading operations and spread on unvegetated areas, it can be an effective means of encouraging natural revegetation (Tom Dayak, CalTrans, pers. comm., October, 1987). Lack of oxygen, too much or too little moisture, high temperature or prolonged storage brings loss of seed viability and a reduction in microorganisms (Kay 1987). Spreading surface soil immediately on a completed grade is least damaging to the living portion of the soil. Dust control specifications require that only the uppermost 2 inches of soil may be conserved during initial grading, but it may be spread to greater depth, such as 4 inches.

Mulching. Mulch nearly always shortens the time needed to establish a suitable plant cover (Kay 1978). The benefits of mulch in erosion control and revegetation include:

1) Mulch intercepts raindrops, reducing their erosional force;
2) Some mulches also intercept runoff. This reduces the quantity of soil carried away;
3) Mulches with surface roughness, such as punched straw or gravel, tend to catch and hold wind-carried soil and seed;
4) Many types of mulches encourage water infiltration; and
5) Mulches tend to moderate soil temperatures and retain soil moisture, both critical factors in the arid Mohave Desert.

Available mulching materials include: wood fiber, paper mulch, straw mulch, gravel, hydromulch and chemical stabilizers (Kay and Graves (1983b).

Straw is the recommended mulch material whenever it can be applied (Clary 1983; Kay 1978; Kay and Graves 1983b). The recommended method is punching in 2 to 4 tons/acre in two applications (Bud Kay, pers. comm., November 1987, and Ken Nelson, pers. comm., November 1987). The longest straw has the most stabilizing effect. Rice or other grain straw is better than wild hay because fewer weed seeds are contained. To punch in straw on very steep slopes, a roller must be raised and lowered by a winch (Kay 1978).

In windy sites, straw and other mulches are at risk of blowing away. Chemical stabilizers, or tackifiers, may be used to hold straw in place. However, these are expensive, and are effective only if the straw is well worked into the soil. Another method is broadcast seeding barley or other domesticated grain, which then grows and dies in place, forming a rooted mulch. Since barley is non-persisting in the desert, it does not compete with native species after the first year. The recommended rate is 200-300 lbs/acre alone, or 100 lbs/acre in combination with shrub seed.

For troublesome sites, other types of mulches may be considered. Gravel or rock mulches and jute netting or fiber-

glass mats are highly effective in reducing erosion. While much more expensive than straw mulch (Kay 1978), these alternatives might be considered for small areas.

ADDING PLANT MATERIAL

Spreading surface soil

As indicated earlier, spreading conserved surface soil is a cheap and complete means of re-introducing local seed and microorganisms to newly graded slopes. Surface soil should be spread to a minimum depth of 4 inches as soon as possible after removal from a graded site. It is preferable to move soil between May and December. If initial grading takes place between January and April, most seedlings will be killed, but microorganisms and dormant seed are still of value.

Direct seeding

Several methods may be used for applying seed to soil. Placing seed in, rather than on top of, the soil reduces predation by birds and rodents. Covering seeds by less than 1 cm (0.5 in) encourages maximum emergence (Kay and Graves 1983b). On level ground, the rangeland drill is an ideal tool for applying and covering seed. Rough or steep sites may be seeded by hand, and the seed covered by simply dragging a chain behind a tractor (Clary and Slayback 1984), hand-raking, or allowing the wind to carry in soil to cover (Kay, pers. comm., December 1987).

Where some natural revegetation has already taken place, it is undesirable to disturb the site with mechanical equipment, risking additional erosion. In this case, spot-seeding, a procedure in which a small hole or trench is dug and a small amount of seed is placed just below the soil surface (Chan et al. 1977). This method is advantageous in that it requires very little seed, and can be used any time after final site preparation has taken place.

Hydroseeding, a method in which seeds, wood fiber, water, and fertilizer are sprayed onto bare ground, is generally considered unsuitable for desert applications (Kay 1985; Packer and Aldon 1978; Kay and Graves 1983ba; Clary and Slayback 1984). This method deposits the seeds above ground level. Rainfall followed by a dry spell will cause seeds to germinate, then die from lack of access to soil moisture.

Planting Container Stock

Although using container stock improves establishment and initial rate of growth, the high cost makes it unfeasible to use to any large extent at Coso. A 1977 feasibility study by

Southern California Edison showed that replacing lost desert shrubs with comparable density and species composition of container stock would cost $29,000 per acre; in 1987 dollars, this figure should be doubled, or $55,000 to $60,000 per acre (Dan Pearson, SCE, pers. comm., November, 1987). This figure was corroborated by an estimate that container stock presently costs $4 to $12 per plant installed; and if planted on 3 foot centers, the per-acre cost would be $20,000 to $58,000 (Ken Nelson, pers. comm., November, 1987).

Two species, Joshua trees and creosote bush, both important structural elements in the local vegetation, would benefit from planting as container stock. Due to their high visual impact and importance of Joshua trees to Mohave ground squirrels, small-scale planting of these species is recommended where consistent with surrounding vegetation. This recommendation will be addressed in future annual revegetation plans, as the focus in 1988-89 will be the first-time treatment of a large number of wellpads.

Availability of Seed

Nurseries and seed suppliers specializing in native plants carry a number of plant species indigenous to Coso. However, within-species genetic variation from region to region may be considerable. Custom collection of local seed is ideal. It can be arranged for any quantity of seed and virtually any species; the unit cost decreases with the volume required. Seed can be collected in quantity during productive seed years and stored under controlled conditions, thus reducing cost. The seed collector should report percent live seed.

If custom-collected seed is not available in the quantity required, stocked seed can be used if it has originated from the Mohave Desert from comparable elevation sites.

Which Species Work Best?

In revegetation studies carried out near Little Lake, Clary and Slayback (1984) found *Atriplex polycarpa* was highly successful in direct-seeding trials; its success was attributed to its relative unpalatability to jackrabbits. This species is the principal invading species at Coso as well. 'Marana' fourwing saltbush and *Eriogonum fasciculatum* also performed well in seeding trials at Little Lake. Other species have had limited to poor results, including *Hymenoclea salsola*, *Ephedra nevadensis*, *Larrea tridentata*, and *Oryzopsis hymenoides*. No seeding-trial information is available on *Lycium*, except that Kay *et al*. (1977) found that seed collection was difficult, but the seeds could be germinated and grown.

The choice of species in a seed mix should be determined by

the revegetation objectives, as well as which species are likely to perform well. Atriplex polycarpa should be prominent in the seed mix, since it grows well on disturbed sites, is a major component of surrounding vegetation, and may be of value to the Mohave ground squirrel. Joshua trees should be planted in spot seedings experimentally. All other prominent shrub species should be included in the seed mix if feasible, and their performance evaluated. If erosion control is a persistent problem, use of rabbitbrush (Chrysothamnus nauseosus) should be considered, but it is not desirable. Rabbitbrush comprises an extremely minor part of the local flora and is quite successful and persistent in seedings, thus it might occupy a disproportionate part of the revegetation area.

Grasses have exceptionally good ability to hold surface soil, and are widely used in erosion control. However, annual grasses compete with shrub and forb seedlings and may diminish the success of other efforts. A sparse stand of non-persisting annual grass such as barley is recommended for erosion control and mulch. If barley is used alone, it should be applied at 200-300 lbs/acre. If used in combination with native shrub seed (recommended application rate of 20 lbs/acre or with spot seeding), barley should be applied at 100 lbs/acre.

Timing of revegetation efforts

Direct seeding is most successful in late fall (October-November) (Kay and Graves 1983a). Seeding is best carried out before winter rains but when risk of prolonged drought is minimal. Seeding immediately following grading must be done at any season, but it is preferable to do so during the dry months. Re-treatment may be required to achieve acceptable results.

FOLLOWUP CARE

Irrigation

The prevailing view on irrigation in the desert is that while it may help in the short term, it is of little benefit in the long run. Direct seedings are usually not irrigated. Most authors agree that if the correct species are planted in the fall or early winter and there is normal rainfall afterward, there is no benefit from irrigation (Kay and Graves 1983b).

Tyson (1984) explains the non-irrigation rationale as follows:

> "There is a widespread misconception that a native plant can be planted on any site, irrigated temporarily, and then left to "natural forces". In practice, temporary irrigation commonly produces a larger leaf area than without irrigation. If roots cannot absorb enough water to support the

leaves, the plant will decline or die. There is little or no theoretical or practical justification for temporary irrigation of long-lived vegetation".

Irrigation of revegetation sites is not recommended at this time. In fact, watering for dust control must be taken into account when planning seeding to avoid stimulating seeds at an inappropriate season into germination, as they are likely to perish when the watering ceases. The recommendation here is to seed barley on fill slopes within 24 hours following the final grading and watering.

Fertilizer

Although fertilizer is usually applied with mulch to compensate for nitrogen removed from the soil by decomposition (Kay 1978), this process is very slow in the desert. However, one study (Clary 1983) showed that fertilizing freeway cut slopes in the desert speeded natural re-establishment of indigenous vegetation. This treatment might be tested, since cost is minimal.

Repeating treatments

Any revegetation effort is at the mercy of the weather. Plans should include a contingency for repeated seedings if weather conditions preclude success (Kay and Graves 1983b).

Protection from herbivores

Grazing by herbivores is the single greatest cause of failure of seeded shrubs to survive (Kay and Graves 1983a). Jackrabbits are a common culprit, although rodents also play a role. Wire cages are essential to achieve reasonable success with container stock, and may be helpful in direct seeding as well. The usual wire cage is 3 inches in diameter and 15 inches high. Larger cages are recommended by some (Racin and Dayak 1986), and perforated plastic cages are available which photodegrade in three to five years (Clary 1983). Since poison bait programs or trapping are unacceptable methods of herbivore control, the use of cages should be considered as protection against rodents and jackrabbits.

Wire cages may accelerate establishment of important food plants for the Mohave ground squirrel and help avoid repeated seeding. Their utility will be highest when used selectively on highly palatable species. They should be tested to determine cost-effectiveness.

The wire cages described here are useless against livestock. Until cattle and burros can reliably be kept away, revegetation efforts are at risk.

REFERENCES CITED

California Association of Resource Conservation Districts. 1986. California Interagency seeding guide for erosion control plantings. 6 pp.

California Energy Company. 1987. Plans of utilization and disposal for two 48 megawatt power plants. California Energy Company, Santa Rosa, CA. 36 pages plus attachments.

Chan, Franklin J., Richard W. Harris, and Andrew Leiser. 1977. Direct seeding woody plants in the landscape. University of California Agricultural Extension Leaflet 2577. 12 pp.

Clary, Raimond F., Jr. 1983. Planting techniques and materials for revegetation of California roadsides. U.S. Dept. of Agriculture, Soil Conservation Service, Lockeford, CA. 161 pp.

Clary and Slayback 1984. Revegetation in the Mojave Desert using native woody plants. In: Proceedings of the symposium on native plant revegetation, November 15, 1987, San Diego, CA. pp.42-47.

Kay, Burgess L. 1978. Mulches for erosion control and plant establishment on disturbed sites. University of California Agronomy Progress Report No. 87. University of California, Davis. 19 pp.

_____. 1979. Summary of revegetation attempts on the second Los Angeles aqueduct. Mohave Desert Revegetation Note No. 22. University of California, Davis, Department of Agronomy and Range Science. 24 pp.

_____. 1984. Cost and effectiveness of mulching practices. In: Proceedings of the Sixth High Altitude Revegetation Workshop, Colorado State University, Ft. Collins,. CO, March 5-6, 1984. 12 pp.

_____. 1985. Important revegetation concepts with emphasis on the Mohave-Tehachapi area. 7 pp.

_____. 1987. Considerations in revegetation planning. California Geology. January 1987. pp. 7-9.

_____ and Walter Graves. 1983a. Revegetation and stabilization techniques for disturbed desert revegetation. Chapter 17 in Environmental Effects of Off-Road Vehicles, Impacts and Management in Arid Regions. Webb, R.H. and H.G. Wilshire (eds.). Springer-Verlag. 534 pp.

_____. 1983 b. History of revegetation studies in the California deserts. Chapter 16 in Environmental Effects of

Off-Road Vehicles, Impacts and Management in Arid Regions. Webb, R.H. and H.G. Wilshire (eds.). Springer-Verlag. 534 pp.

Kay, Burgess L., Catherine M. Ross, and Walter Graves. 1977. Mojave revegetation notes. University of California Cooperative Extension, Davis. (Twenty-one separate monographs of 2-10 pages each).

Packer, P.E. and E.F. Aldon. 1978. Revegetation techniques for dry regions. In: M. Stelly (ed.), Reclamation of drastically disturbed lands. American Society of Agronomy, pp. 425-450.

Racin, James A. and Tom Dayak. 1986. Revegetation of highway slopes in the high desert with native plant seedlings: interim report. California Department of Transportation, Sacramento, CA. 56 pp.

Tyson, Wayne. 1984. Revegetation by objectives. Proceedings from the conference on revegetation, San Diego,. CA. pp 10-14.

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APPENDIX F
Air Quality Tables

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9/18/2008

Urbemis 2007 Version 9.2.4

Detail Report for Annual Construction Unmitigated Emissions (Tons/Year)

File Name: C:\Documents and Settings\DDeckman\My Documents\Projects\Coso\CosoOpCo_Construction.urb924

Project Name: Coso Operating Company

Project Location: Mountain Counties Air Basin

On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006

Off-Road Vehicle Emissions Based on: OFFROAD2007

CONSTRUCTION EMISSION ESTIMATES (Annual Tons Per Year, Unmitigated)

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10 Total	PM2.5 Dust	PM2.5 Exhaust	PM2.5 Total	CO2
2009	0.26	2.18	1.04	0.00	0.00	0.10	0.10	0.00	0.09	0.09	200.69
Pipeline Installation Phase 1 (50 day) 04/01/2009-05/21/2009	0.12	1.04	0.48	0.00	0.00	0.05	0.05	0.00	0.04	0.04	92.45
Off Road Diesel	0.12	1.04	0.40	0.00	0.00	0.05	0.05	0.00	0.04	0.04	88.22
Worker Trips	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.23
Pipeline Installation Phase 2 (20 day) 05/22/2009-06/11/2009	0.02	0.17	0.08	0.00	0.00	0.01	0.01	0.00	0.01	0.01	16.56
Off Road Diesel	0.02	0.17	0.07	0.00	0.00	0.01	0.01	0.00	0.01	0.01	15.80
Worker Trips	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.76
Pipeline Installation Phase 3 (50 day) 06/12/2009-08/01/2009	0.07	0.59	0.26	0.00	0.00	0.03	0.03	0.00	0.02	0.02	54.09
Off Road Diesel	0.07	0.59	0.21	0.00	0.00	0.03	0.03	0.00	0.02	0.02	51.81
Worker Trips	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.29
Pipeline Installation Phase 4 (30 day) 08/03/2009-09/02/2009	0.05	0.38	0.22	0.00	0.00	0.02	0.02	0.00	0.02	0.02	37.59
Off Road Diesel	0.05	0.38	0.17	0.00	0.00	0.02	0.02	0.00	0.02	0.02	34.95
Worker Trips	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.63

Phase Assumptions

Phase: Pipeline Installation 4/1/2009 - 5/21/2009 - Phase 1

Off-Road Equipment:

2 Crawler Tractors (185 hp) operating at a 0.64 load factor for 8 hours per day

1 Excavators (168 hp) operating at a 0.57 load factor for 8 hours per day

1 Graders (150 hp) operating at a 0.61 load factor for 8 hours per day

1 Trenchers (172 hp) operating at a 0.75 load factor for 8 hours per day

2 Welders (23 hp) operating at a 0.45 load factor for 8 hours per day

2 Water Trucks (189 hp) operating at a 0.5 load factor for 8 hours per day

9/18/2008

Phase: Pipeline Installation 5/22/2009 - 6/11/2009 - Phase 2

Off-Road Equipment:

1 Excavators (168 hp) operating at a 0.57 load factor for 8 hours per day

1 Rubber Tired Loaders (164 hp) operating at a 0.54 load factor for 8 hours per day

2 Water Trucks (189 hp) operating at a 0.5 load factor for 8 hours per day

Phase: Pipeline Installation 6/12/2009 - 8/1/2009 - Phase 3

Off-Road Equipment:

1 Crawler Tractors (185 hp) operating at a 0.64 load factor for 8 hours per day

1 Graders (150 hp) operating at a 0.61 load factor for 8 hours per day

1 Rubber Tired Loaders (164 hp) operating at a 0.54 load factor for 8 hours per day

2 Water Trucks (189 hp) operating at a 0.5 load factor for 8 hours per day

Phase: Pipeline Installation 8/3/2009 - 9/2/2009 - Phase 4

Off-Road Equipment:

1 Cranes (399 hp) operating at a 0.43 load factor for 8 hours per day

1 Excavators (168 hp) operating at a 0.57 load factor for 8 hours per day

1 Rollers (174 hp) operating at a 0.56 load factor for 8 hours per day

1 Rubber Tired Loaders (164 hp) operating at a 0.54 load factor for 8 hours per day

4 Welders (23 hp) operating at a 0.45 load factor for 8 hours per day

1 Water Trucks (189 hp) operating at a 0.5 load factor for 8 hours per day

9/18/2008

Urbemis 2007 Version 9.2.4

Detail Report for Summer Construction Unmitigated Emissions (Pounds/Day)

File Name: \\Hqtr-data1\projects_old\300.Environmental\6106_Coso_Operating_Company\AQ\URB File\CosoOpCo_Construction.urb924

Project Name: Coso Operating Company

Project Location: Mountain Counties Air Basin

On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006

Off-Road Vehicle Emissions Based on: OFFROAD2007

CONSTRUCTION EMISSION ESTIMATES (Summer Pounds Per Day, Unmitigated)

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10 Total	PM2.5 Dust	PM2.5 Exhaust	PM2.5 Total	CO2
Time Slice 4/1/2009-5/21/2009 Active	**6.67**	**56.24**	**25.89**	**0.00**	**0.01**	**2.61**	**2.62**	**0.00**	**2.40**	**2.41**	**4,997.32**
Pipeline Installation Phase 1 (50 day) 04/01/2009-05/21/2009	6.67	56.24	25.89	0.00	0.01	2.61	2.62	0.00	2.40	2.41	4,997.32
Off Road Diesel	6.50	55.98	21.65	0.00	0.00	2.61	2.61	0.00	2.40	2.40	4,768.43
Worker Trips	0.17	0.26	4.24	0.00	0.01	0.01	0.02	0.00	0.01	0.01	228.89
Time Slice 5/22/2009-6/11/2009	2.67	22.72	10.94	0.00	0.00	1.05	1.06	0.00	0.97	0.97	2,207.93
Pipeline Installation Phase 2 (20 day) 05/22/2009-06/11/2009	2.67	22.72	10.94	0.00	0.00	1.05	1.06	0.00	0.97	0.97	2,207.93
Off Road Diesel	2.59	22.60	9.06	0.00	0.00	1.05	1.05	0.00	0.97	0.97	2,106.20
Worker Trips	0.07	0.12	1.88	0.00	0.00	0.00	0.01	0.00	0.00	0.00	101.73
Time Slice 6/12/2009-7/31/2009	3.75	32.78	14.25	0.00	0.01	1.46	1.47	0.00	1.34	1.35	3,005.22
Pipeline Installation Phase 3 (50 day) 06/12/2009-08/01/2009	3.75	32.78	14.25	0.00	0.01	1.46	1.47	0.00	1.34	1.35	3,005.22
Off Road Diesel	3.65	32.63	11.89	0.00	0.00	1.46	1.46	0.00	1.34	1.34	2,878.06
Worker Trips	0.09	0.15	2.35	0.00	0.01	0.00	0.01	0.00	0.00	0.01	127.16
Time Slice 8/3/2009-9/2/2009	4.21	33.22	19.08	**0.00**	**0.01**	1.63	1.64	**0.00**	1.50	1.51	3,268.31
Pipeline Installation Phase 4 (30 day) 08/03/2009-09/02/2009	4.21	33.22	19.08	0.00	0.01	1.63	1.64	0.00	1.50	1.51	3,268.31
Off Road Diesel	4.04	32.95	14.84	0.00	0.00	1.63	1.63	0.00	1.50	1.50	3,039.42
Worker Trips	0.17	0.26	4.24	0.00	0.01	0.01	0.02	0.00	0.01	0.01	228.89

Phase Assumptions

Phase: Pipeline Installation 4/1/2009 - 5/21/2009 - Phase 1

Off-Road Equipment:

2 Crawler Tractors (185 hp) operating at a 0.64 load factor for 8 hours per day

1 Excavators (168 hp) operating at a 0.57 load factor for 8 hours per day

1 Graders (150 hp) operating at a 0.61 load factor for 8 hours per day

1 Trenchers (172 hp) operating at a 0.75 load factor for 8 hours per day

2 Welders (23 hp) operating at a 0.45 load factor for 8 hours per day

9/18/2008

2 Water Trucks (189 hp) operating at a 0.5 load factor for 8 hours per day

Phase:Pipeline Installation 5/22/2009 - 6/11/2009 - Phase 2
Off-Road Equipment:
1 Excavators (168 hp) operating at a 0.57 load factor for 8 hours per day
1 Rubber Tired Loaders (164 hp) operating at a 0.54 load factor for 8 hours per day
2 Water Trucks (189 hp) operating at a 0.5 load factor for 8 hours per day

Phase: Pipeline Installation 6/12/2009 - 8/1/2009 - Phase 3
Off-Road Equipment:
1 Crawler Tractors (185 hp) operating at a 0.64 load factor for 8 hours per day
1 Graders (150 hp) operating at a 0.61 load factor for 8 hours per day
1 Rubber Tired Loaders (164 hp) operating at a 0.54 load factor for 8 hours per day
2 Water Trucks (189 hp) operating at a 0.5 load factor for 8 hours per day

Phase: Pipeline Installation 8/3/2009 - 9/2/2009 - Phase 4
Off-Road Equipment:
1 Cranes (399 hp) operating at a 0.43 load factor for 8 hours per day
1 Excavators (168 hp) operating at a 0.57 load factor for 8 hours per day
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4 Welders (23 hp) operating at a 0.45 load factor for 8 hours per day
1 Water Trucks (189 hp) operating at a 0.5 load factor for 8 hours per day

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APPENDIX G
Revegetation Plan

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1988 REVEGETATION PLAN FOR THE CHINA LAKE JOINT VENTURE GEOTHERMAL DEVELOPMENT

COSO KNOWN GEOTHERMAL RESOURCES AREA

prepared for McClenahan and Hopkins Associates
276 Purdue Avenue
Kensington, CA 94708

by

Barbara Malloch Leitner
5944 Taft Avenue
Oakland, CA 94618

June 28, 1988

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PREFACE

Several factors should be considered when planning revegetation at the Coso Known Geothermal Resource Area:

1. Growth of desert plants is slow even under the most favorable conditions, and revegetation will also be slow.

2. Weather is the single most influential factor, and its extreme variability confounds revegetation planning and brings mixed results.

3. Wind and dryness are the enemies of revegetation; both are present in quantity at Coso.

4. Artificially augmented plant growth brings on additional risk: watering and fertilization enhance leaf growth which can be suppported only by continued regular care for an indefinite period of time. Also, both watering and fertilization increase plant palatability to herbivores.

5. The remoteness of the Coso site makes intensive maintenance of a revegetation program difficult, although regular review of progress is required.

6. The continued presence of burros and cattle reduces the likelihood of success of a revegetation program.

These factors suggest that the most successful revegetation plan is one which relies primarily on natural processes and requires little intervention once site preparation is complete.

In order of priority, the two principal objectives of pre-abandonment revegetation at Coso are erosion control and the use of indigenous native plant species to help compensate for lost habitat for the threatened Mohave ground squirrel (*Spermophilus mohavensis*). These objectives can be accommodated concurrently, with the greater emphasis on erosion control in the initial stages.

The revegetation program outlined here calls for clearly-defined objectives, good site preparation, use of native seed, limited followup care and periodic monitoring.

INTRODUCTION

Geothermal development at the Coso Known Geothermal Resource Area (KGRA) by the China Lake Joint Venture (CLJV) involves the commitment of land for roads, pipelines, wellpads, power plants and transmission facilities. Most of the land is committed for the life of the project, but an estimated 5 percent consists of temporary use areas and cut and fill slopes. Treatment of these lands, present and future, is the subject of this plan. At this time, one power plant and 25 wellpads have been constructed; an additional power plant site and two wellpads are presently under construction; and two additional power plants and a number of wellpads are planned. This plan addresses the specific treatment of each existing facility, and sets forth procedures for in-progress and future work.

CLJV is presently operating under permit conditions requiring revegetation of unvegetated cut and fill slopes, stockpiling topsoil, use of indigenous plant species in revegetation, and whatever additional measures are required by the China Lake Naval Weapons Center (NWC) and Bureau of Land Management (BLM) to satisfactorily control erosion. In addition, the California Department of Fish and Game (CDFG) must approve of elements of the revegetation plan which affect wildlife habitat. This revegetation plan primarily addresses the use of plant material, and includes procedures for grading and maintenance of existing and future cut and fill slopes as these practices relate to revegetation.

Loss of wildlife habitat is the principal impact to biological resources from the Coso development, and of particular concern is the loss of habitat for the state-listed threatened Mohave ground squirrel (*Spermophilus mohavensis*). Information is presently being developed on the habitat requirements of this species as part of other mitigation measures on CLJV projects. The use of suitable plant materials in revegetation can help to compensate for, and in part replace, lost habitat for the Mohave ground squirrel.

Abandonment is not addresssed in this plan, since virtually no land is considered by CLJV to be abandoned at this time. The site-specific experience derived from revegetation efforts now will set the stage for effective revegetation when more extensive areas will be reclaimed upon abandonment.

OBJECTIVES

This plan is designed to meet two objectives: first and foremost, erosion control; second, the establishment of indigenous vegetation resembling that of the nearby landscape, with a priority on the use of plant materials having habitat value for the Mohave ground squirrel.

METHODS

Information on previous work on revegetation in the Mohave Desert was reviewed. Published material included reports prepared by the University of California Cooperative Extension, the U.S. Soil Conservation Service (SCS), and the California Department of Transportation, as well as proceedings from recent revegetation symposia. Knowledgeable individuals were also contacted by telephone to obtain additional information. Burgess L. (Bud) Kay, an authority on Mohave Desert revegetation, conducted a preliminary site visit in December, 1987. Drafts of this plan were reviewed by California Energy Company (Cal Energy, the operator for CLJV), NWC, BLM, and CDFG.

DESCRIPTION OF THE REVEGETATION SITE

The CLJV geothermal development is located at 3000 to 4500 feet elevation in the Coso Range, China Lake Naval Weapons Center, Inyo County, California. Summers are hot and winters are cold. Freezing temperatures may be expected from at least November through March. Mean monthly temperatures range from about 40 degrees F (December) to about 85 degrees F (July-August). The area is subject to strong winds throughout the year.

Annual precipitation ranges from 3 to 6.5 inches (Environmental Monitoring and Services Center, 1980). Most precipitation falls in the winter. Occasional summer thundershowers take place in July and August; although sporadic, these storm events may have a significant influence on revegetation efforts. They provide important moisture during the critical summer months, but their intensity also presents potential for erosion caused by runoff.

Although the area has a complex geologic history, much of the present and proposed development is on recent volcanic formations. Slopes are gentle to rather steep (0 to 30 percent slopes in most developed areas). The soils are formed over welded tuff, or over sediments derived from tuff. Maynard Lake coarse sands predominate; coarse-textured sands are found on sideslopes and fine-textured material in alluvial basins. Coso-Rock Outcrop stony sandy loams are found on the higher slopes and upper basins (WESCO 1980).

The botanical features present include three natural communities: Mohave creosote bush scrub, Mohave mixed woody scrub; and desert saltbush scrub (Holland 1986). No rare and endangered plants are known to occur in the area presently being developed. The NWC resource staff have identified the Joshua tree (*Yucca brevifolia*) and the cottontop cactus (*Echinocactus polycephalus*) as plant species of special management concern within the KGRA. Transplanting of young, healthy Joshua trees

within the subject operating area is recommended when practical to reduce project impacts (Leitner and Leitner 1987). This action appears as an approval condition attached to specific project permits, as appropriate. Salvage of the cottontop cactus may be carried out at the discretion of NWC.

THE REVEGETATION PROCESS

Certain aspects of the revegetation process are common to all sites:

1) A site evaluation is carried out to identify site condition and needs for revegetation and erosion control;

2) Revegetation procedures are developed, consisting of a site-by-site description of work needed;

3) In areas such as Coso where revegetation efforts are relatively new, testing of treatments helps to determine the most effective approach for the site conditions. Testing at this stage of the revegetation process is important for developing procedures that will be used more extensively during the abandonment phase.

4) Implementation is carried out by qualified contractors.

5) Monitoring is needed to assure that objectives have been met.

6) Review, evaluation and planning are carried out regularly to determine the effectiveness of various methods and to plan for future revegetation.

THE REVEGETATION PLAN

The revegetation plan presented here will proceed according to the steps outlined in the section above. What follows is a description of standard procedures. Some are common to all revegetation sites. Where a choice of treatment is available, the criteria for the selection of a treatment is given. Specific actions are outlined in Appendix I for each of 25 already-constructed wellpads; the Navy 1 power plant and fill disposal areas; and all future and under-construction wellpads. Appendix II presents a more detailed discussion of revegetation practices reviewed for their applicability at the Coso site.

1. Site Evaluation

A preliminary site evaluation was carried out in December, 1987 to assess revegetation needs and the feasibility of using various techniques. A preliminary plan was reviewed by Cal Energy, NWC, and BLM; this plan incorporates their comments.

Further evaluation will be carried out to develop a baseline on physical conditions at revegetation sites. Soils from representative sites will be collected and sent to SCS or a private laboratory for analysis of soil texture, water-holding capability, and available nitrogen, phosphorus, and potassium. These samples will be taken from wellpads 54-7, 72-18, 51-17, 64-18 (Navy 2 pad R), and BLM 1 Pad A to document typical conditions. Most pads are constructed on sites within the Maynard Lake soils mapping unit and are expected to be similar in their chemical and physical properties. More samples will be taken from additional sites if a wide variation in soil conditions is evident from this initial sampling. To assess potential low fertility soil conditions, soil samples will be taken from wellpads 75-7, 41-8, 73-19, 72-19 and 24-20. The angle and condition of each cut and fill slope will be documented and incorporated into a site-specific data base to be maintained on each revegetated site.

2. Revegetation Procedures

Short-term erosion control and long-term erosion control and revegetation needs must be addressed for all unvegetated sites. The present degree of erosion hazard and natural revegetation will dictate the emphasis placed on each. Slopes with little erosion hazard and some natural revegetation will require the least treatment; newly-graded slopes or existing slopes with rill and gully erosion, a history of frequent maintenance, or evidence of low-fertility soils will require the most intensive treatment.

The standard approach here to short-term erosion control is broadcasting barley seed. Barley is quick to form a dense, shallow root system to hold the soil, but is non-persisting in the desert and thus does not compete with native species after the first year. If a high erosion hazard exists, a dense seeding of barley is applied the first year. Long-term erosion control and revegetation is not attempted until slope stability is improved. On existing slopes not already treated for revegetation, barley will be applied in the fall (late October to early November) just before the onset of winter rains. Barley should be applied to newly completed slopes within 24 hours of final grading to allow loose soil to cover the seed. No watering is required.

Long-term erosion control and revegetation is approached through the use of indigenous plant materials. Seeding with perennial shrubs is the main element, although some native perennial grass seed will be included as well (see "Choice of plant materials" below). Sites with some natural revegetation and/or low erosion hazard will be spot seeded, a hand application measure described by Chan *et al*. (1977). In this treatment, a few seeds are placed into a hand-excavated shallow pit, and

covered by a small amount of soil. Spot seeding can be done in any density specified; the recommended density here is on 6 foot centers. The procedure will be carried out in the fall, preferably late October. No additional watering is required. Fill slopes of future pads will receive an application of conserved surface soil; an application of 4 to 6 inches is recommended. The effectiveness of surface soil alone in encouraging growth of native shrubs will be compared with surface soil spreading plus broadcast seeding (see "Testing of Treatments", below).

Dust control is an ongoing air quality issue in the Coso area, and specific measures to control fugitive dust have been taken into account when planning revegetation work. Watering during grading is required for dust control; it helps the soil to form a crust. However, a heavy application of water may stimulate germination and cause subsequent seedling mortality. As a result, seeding should be timed to closely follow these dust control measures to achieve the benefit of some blown soil to cover seed, but avoid excessive moisture. Seeding is recommended within 24 hours following final grading.

A more detailed discussion of each type of revegetation site is presented below.

Existing cut slopes. Erosion hazard on cut slopes is generally not a problem, so use of broadcast seeded barley and native seed is not planned. Cut slopes will be spot seeded with a native shrub-grass mixture. The density of planting will depend on the degree of natural revegetation already in place.

Very little active maintenance is needed for most cut slopes. Natural seedfall from undisturbed slopes above is an excellent source of seed. Alluvium collecting on the wellpad from erosion of the cut slope will be allowed to assume its natural angle of repose and will not be graded off.

Existing fill slopes. Fill slopes are more susceptible to erosion than the more compacted cut slopes, and they lack a nearby source of native seed. Consequently, fill slopes require more attention than cut slopes. The following practices will be applied to fill slopes:

- Fill slopes with pronounced rill and gully erosion (shown as a plus (+) in the erosion column of the Appendix I tables) with a history of maintenance will be seeded in the fall. The recommended application rate for erosion control is 300 lbs/ac of barley. Spot seeding with a native seed mix will be done the following fall or when the slope shows signs of improved stability. Sites with minor rill and gully erosion will be discussed with Cal Energy maintenance to ascertain the anticipated maintenance schedule; these sites may be

seeded with 300 lbs/ac barley in the fall (late October) or left until regrading, when they will be treated as for a newly-graded site.

- Fill slopes with low erosion hazard (shown as a minus (-) in Appendix I under "erosion") but having no natural revegetation (shown as a minus (-) in Appendix I under "natural revegetation") will be broadcast seeded in the fall (late October) with 100 lb/ac barley and spot seeded with a native seed mix.

- Slopes with low erosion and good natural revegetation (shown as a plus (+) in Appendix I under "Natural Revegetation") will receive no barley seeding but will be spot-seeded in late October with a native seed mix.

Standard procedures for newly graded sites. The principal short-term erosion control measure, as with older graded sites, is the use of direct-seeded barley. For long-term erosion control and revegetation, use of conserved surface soil is the most important element. Cut and fill slopes constructed in connection with wellpds, roads, power plant sites, or any other related facilities will be treated according to the following methods.

Before grading begins on a new site, the application site for conserved surface soil will be identified and a plan developed for its use. Newly graded sites will have the surface soil (no less than 2 inches and no more than 4 inches) collected for application on final-graded fill slopes. For a standard size 6 acre wellpad (including cut and fill slopes), conserved soil removed to the minimum depth of 2 inches will amount to 1,613 cubic yards of volume. If an average depth of 3 inches is taken, about 2,400 cubic yards will result.

Conserved surface soil quickly deteriorates when stockpiled, and the benefit to revegetation likewise diminishes. Collecting and applying conserved surface soil in the same operation is the least expensive method, since the soil must be loaded and unloaded only once. To assure viability of surface soil organisms, application to a completed fill slope must take place within 24 hours of initial grading during the season (November-April and within one week of any summer precipitation exceeding 0.25 inches). When soils are dry, they must be applied within 5 days of collection.

Conserved surface soil will be applied to newly completed fill slopes to a depth of 4 to 6 inches, and smoothed and compacted according to existing requirements for engineering and dust control. Maximum surface roughness will be sustained.

Standard mitigation measures for the preservation of Joshua

trees will also be observed, including avoiding surface disturbance within 50 ft of a Joshua tree whenever possible, and transplanting Joshua trees when necessary to avoid their loss.

New cut slopes will be treated as follows:

1) Where the maximum cut is 20 ft or less of depth, the angle of cut will be 2:1. Where the maximum cut exceeds 20 ft due to sloping terrain, the angle of cut will range between 2:1 and 1:1 as needed.
2) For each 10 ft of depth, a contour trench at least 6 inches in width will be constructed in the cut slope.
3) Maintain maximum surface roughness during final grading.

New fill slopes will be treated as follows:

1) Slopes will be graded as close to a 3:1 slope as possible.
2) During final grading, conserved surface soil will be applied to the slope. The recommended rate is 4 to 6 inches.
3) Maintain maximum surface roughness with tractor cleats.
4) Apply broadcast-seeded barley at 100 lb/acre as soon as possible, preferably within 24 hours of final grading and watering, and allow soil to cover.
5) If surface soil is not available, broadcast seed at 20 lb/ac with native seed mix immediately following grading or in late October.

Laydown areas. Laydown areas are considered to be areas of disturbance and must be permitted by the same procedure as wellpads. It should be noted that no laydown areas presently exist, since wellpads have been used for this purpose. Laydown areas are areas bladed to remove vegetation but the surface topography has not been altered. They generally have been compacted from the action of heavy equipment, and this compaction must be relieved to achieve good revegetation. Seeding with barley is not expected to be required, since laydown areas are generally level and do not present an erosion hazard. Treatment of laydown areas which are not expected to be re-used is as follows:

1) If creosote bush was present, harrow lightly to relieve compaction without damage to root crowns.
2) If no creosote bush, rip to a depth of 18 inches.
3) Spread surface soil to a depth of 4 to 6 inches, if available.
4) If surface soil is not available for application, broadcast seed a native seed mix at 20 lb/ac in late October.

Transmission lines. CLJV constructed the 28.5 mile 115 k/v Devil's Kitchen-Inyokern transmission line in the summer of 1986. Site inspections of the construction area in 1987 and 1988 show that natural revegetation has occurred at a fast enough rate to

stabilize soils and prevent erosion; no further actions are proposed. New transmission lines, including the 220 kV line and taps from power plants to the line, will be treated as follows:

1) Vegetation will be crushed instead of bladed at the structure sites and along spur access roads whenever topography allows. Crushing instead of blading preserves soils and seed sources on-site.
2) In areas of greater topographic relief where cut and fill slopes are required, such slopes will be treated as described above, under "Standard procedures for newly graded sites; cut and fill slopes".

Choice of plant materials. Desert saltbush (*Atriplex polycarpa*), fourwing saltbush (*A. canescens*), and buckwheat (*Eriogonum fasciculatum*) have produced good results in seeding trials carried out by the California Department of Transportation near the Coso area (Clary and Slayback 1984). Limited to poor success was obtained from cheesebush (*Hymenoclea salsola*), Mormon-tea (*Ephedra nevadensis*), creosote bush (*Larrea tridentata*), and Indian ricegrass (*Oryzopsis hymenoides*). No information on seeding trials using spiny hopsage (*Grayia spinosa*) was available, although it is a significant component of the desert scrub community in the Coso area.

On the basis of these trials, the three most successful species (which also are important components of the shrub layer in the Coso KGRA) will comprise 70 percent of the seed mix. The remaining 30 percent will be composed of species which also are important structural components of the natural communities present. Although these species may not establish themselves in high numbers, it is anticipated that at least some of them will become established.

The native seed mix is as follows (percentages are by weight):

Atriplex polycarpa	30%
Atriplex canescens	30%
Eriogonum fasciculatum	10%
Hymenoclea salsola	10%
Oryzopsis hymenoides	5%
Ephedra nevadensis	5%
Grayia spinosa	5%
Stipa speciosa	3%
Eurotia lanata	2%

This mix will be used assuming commercial availability. The recommended seeding rate is based on percent live seed. Seed will be custom collected from the vicinity of the Coso area (within 25 miles, if possible, and from an elevation range of 3000 to 4500 ft elevation). If seed production is poor for

certain species which are commercially available, a portion of the seed mix may be obtained from existing stock, provided it originated from the Mohave Desert.

Initially, this choice of seed mix is based on successful tests nearby in the Mohave Desert. It will be modified as the results of seeding tests become available for the Coso site, and as more information is collected on the habitat requirements of the Mohave ground squirrel as part of the Coso Grazing Exclosure mitigation program.

Annual forb (broadleaf) seed is not recommended for the initial stages of this revegetation program, although it might be considered at a later time. The reasons are: forbs used in initial seeding may present more competition for shrub seedlings; and the presence of forbs may attract herbivores before the shrub seedlings are able to tolerate browsing. Forb seeding will be reconsidered when the shrub layer is well established. Cal Energy will seed with forbs as directed by the agencies responsible for the Coso Mohave ground squirrel mitigation plan, since this action would be undertaken principally as a habitat enhancement action for this threatened species.

Post-treatment maintenance. This revegetation plan is designed to require a minimum of post-treatment care. The plant species selected for use are adapted to prevailing conditions. Irrigation is not planned because plants watered during their early establishment develop a root and leaf structure dependent on continued water. Kay and Graves (1983) found no benefit from irrigation when suitable species are planted in the fall or early winter and normal amounts of rainfall followed.

Re-treatment. In the event that rainfall is extremely unfavorable, retreatment similar to initial treatment will be required, including broadcast seeding and/or spot seeding. Retreatment will also be required after maintenance grading; annual inspections by Cal Energy and NWC (and BLM as appropriate) will determine the advisability of regrading slopes, taking revegetation efforts into account.

Criteria for success. As an initial standard, shrub densities on sites treated for revegetation should after 5 years support a density of shrubs equal to about 60 percent of the density found at the benchmark monitoring sites (see monitoring section). Shrub size will obviously be less on revegetation sites. If the density standard is not met, spot seeding or other measures will be repeated to achieve the desired shrub density.

3. Testing of Treatments

The most important treatments to be tested at this stage are as follows: 1) mulching with straw; 2) use of herbivore protectors; 3) use of fertilizer; and 4) broadcast seeding with a

native seed mix on newly completed slopes. Appendix I shows the experimental design of treatments. Two replicates, as similar as possible, were selected for each treatment, with the exception of straw mulch and broadcast seeding. These treatments must be applied to newly-completed slopes and replicates will be designated as they become available.

It should be noted that the monitoring program will also provide an opportunity for comparison of treatments, such as the success of the seeding mix on different slopes and exposures, the success of surface soil spreading against direct seeding, and a comparison of revegetation rates on different soil types, slopes and exposures. This type of information, while not testing in the experimental sense, will provide valuable information for future planning in revegetation.

4. Implementation

Much construction activity has been initiated in the calendar year 1988, and a large number of previously untreated slopes must be addressed. Implementation in 1988 will include:

- Evaluate soils further;
- Collect local seed;
- Engage contractor(s) to apply stockpiled surface soil, carry out broadcast seeding, spot seed, and install rodent protectors, straw mulch, and fertilizer;
- Identify a monitor for revegetation evaluation; and
- Establish an information data base on each revegetation site.

5. Monitoring

Criteria for evaluation. The monitoring phase of the revegetation program will include a comparison of revegetation sites against undisturbed sites for which vegetation characteristics are well known. The "benchmark" reference sites may consist of adjacent undisturbed vegetation, or of nearby sites which resemble the soil, slope, and exposure of the revegetation site. However, the characteristics of sites known to support high densities of Mohave ground squirrels may also be used as reference sites against which revegetation success is measured. Ultimately, success of the revegetation program is achieved when the species composition, frequency, density, cover and biomass approximates that of the benchmark reference site. An interim measure of success is to achieve within 5 years a shrub density which is 60 percent of the benchmark site.

Methods. Reference sites will be selected on the basis of the pre-existing vegetation and desired characteristics for Mohave ground squirrel habitat. One reference site may serve for several revegetation sites, if the site characteristics are

reasonably similar. The exact size and location of the reference site will be chosen in the field, but will approximate the size of a wellpad fill slope. The species composition, frequency, density and cover of benchmark reference sites will be measured. The species, size and location of the shrub layer will be mapped on 10 by 10 meter squares. Five to 10 such quadrats will be used for a reference site, depending on the variability of the site. Standing crop, species composition, and estimated cover will be measured for the herb layer using 50 square-foot plots.

Monitoring at the revegetation sites will be characterized in a similar manner. However, care must be taken in the initial years not to allow excessive foot traffic on the cut and fill slopes. Treading breaks the crust formed on the soil surface, encouraging wind and water erosion. At first, only the shrub layer will be characterized using 10 by 10 meter areas. This can be done by observers standing on the upper and lower edges of most fill slopes. Herbaceous vegetation will be noted as to species composition for each site, but intensive measurement is not recommended initially because of the erosion hazard.

Monitoring will be carried out annually at the revegetation sites. After the initial survey, the reference sites will be re-surveyed every five years until project abandonment. Productivity will be estimated from limited plant clipping, as feasible without adversely affecting the progress of the revegetation process.

Establishing a data base for revegetation efforts. Over two dozen graded sites, several soil types and exposures, and a number of experimental treatments will quickly become unwieldy to track without a systematic means of recording and updating information. A data base will be established, with the following elements:

1) A site map showing each graded site at 1:200, and a master site map showing each wellpad, by section;
2) Oblique photographs of each pad, taken every two years;
3) A record of the "as-built" areas of disturbance for each pad;
4) Information on slope, rill and gully erosion, and the physical and chemical composition of the soils, as this information is available;
5) Records of the date of pad construction, dates of any pad maintenance as it relates to revegetation efforts; and
6) A record of the date and type of revegetation treatments.

The most important aspect of monitoring is the feedback loop it provides for future planning. The relative success of various methods can be used to achieve optimum revegetation strategies for the future. As a result, the monitoring results will be written up annually and attached to the annual revegetation plan.

6. Review, Evaluation and Planning

An evaluation of revegetation actions and monitoring results will be conducted annually. Cal Energy will submit an updated revegetation plan for NWC, BLM and CDFG approval. The most useful time for a review would be in late summer or early fall, when seedling germination and establishment for the year is known, and prior to treatments required during late October.

REFERENCES CITED

Chan, Franklin J., Richard W. Harris, and Andrew Leiser. 1977. Direct seeding woody plants in the landscape. University of California Agricultural Extension Leaflet 2577. 12 pp.

Clary, Raimond F. and Richard Slayback. 1984. Revegetation in the Mojave Desert using native woody plants. In: Proceedings of the symposium on native plant revegetation, November 15, 1987, San Diego, CA. Pp. 42-47.

Environmental Monitoring and Services Center. 1980. Air quality technical report on the Coso geothermal study ara. In support of Coso geothermal development environmental statement. Bureau of Land Management, Bakersfield, CA. 173 pp.

Holland, Robert F. 1986. Preliminary descriptions of the terrestrial natural communities of California. California Department of Fish and Game, Sacramento, CA. 156 pp.

Kay, Burgess L. and Walter Graves. 1983. Revegetation and stabilization techniques for disturbed desert revegetation. Chapter 17 in Environmental effects of off-road vehicles, impacts and management in arid regions. Webb, R.H. and H.G. Wilshire (eds.) Springer-Verlag. 534 pp.

Leitner, Barbara Malloch and Philip Leitner. 1987. Report on biological resources, China Lake Joint Venture's BLM 1 field development and power plant construction program, China Lake Naval Weapons Center, California. Prepared for McClenahan and Hopkins Associates, Kensington, CA 45 pp.

WESCO. 1980. Soils technical report on the Coso geothermal area. In support of Coso geothermal development environmental statement. Bureau of Land Management, Bakersfield, CA. 256 pp.

APPENDIX I. SPECIFIC REVEGETATION ACTIONS FOR UNVEGETATED SITES

Table I-A. Navy 1 operating area erosion control and revegetation measures.

Facility	Site Conditions*					Short-term erosion control	Long-term		Test Measures				
	Surface	Exposure	Test soils	Erosion	Natural reveg.	Barley seeding (lbs/ac)	Spot seed natives	Spread surface soil	Fertilizer	Perimeter fence	Plant protectors	Straw mulch	Brackenridge native mix
Navy 1 power plant	Cut	N		-	+		x						
	Fill	NW	+	-	+		x						
Fill disposal	Fill	N		+	-	~300	x						
Wellpad 78-6	Cut	N		-	-		x			Control for			
	Fill	N		-	-	100	x			61-7,63-7			
Wellpad 52-7	Cut	SE		-	-		x			Control for			
	Fill	SE		-	-	Dec. 1987	x			54-7			
Wellpad 54-7	Cut	N		-	-		x		x				
	Fill	N	+	-	-	100	x		x				
Wellpad 61-7	Cut	N		-	-		x						
	Fill	N		-	-	100	x			x			
Wellpad 63-7	Cut	N		-	-		x						
	Fill	N		-	-	100	x				x		
Wellpad 71-7	Cut	N		-	+				Control,				
	Fill	N		-	+				no treatment				
Wellpad 73-7	Cut	N		-	-		x						
	Fill	N		-	-	100	x						
Wellpad 75-7, 76-7, 77-7, 87-7, 15-8	Cut	SW		-	-		x		Compare with				
	Fill	SW	+	+	-	300		in 1989	41-8, poor soil				
Wellpad 78-7	Cut	S		-	-		x						
	Fill	S		-	-	100	x						x
Wellpad 11-8, and 31-8	Cut	N		-	+		x						
	Fill	N		-	+		x						
Wellpad 41-8	Cut	N		-	-		x		x				
	Fill	N	+	-	-	100	x		x				
Wellpad 47-8	Cut	S		-	-		x						
	Fill	S		-	-	100	x			Compare with 78-7			
New developments	Cut						x						
	Fill					100		x		Test	x		x

*Present site conditions:
Exposure: N=north; S=south; E=east; W=west;
Test soils: "+" indicates physical and chemical testing to be done;
Erosion: "-" indicates erosion hazard not significant; "+" indicates maintenance may be required;
Natural revegetation: "+" indicates natural revegetation is evident; "-" indicates little or no natural revegetation.

Table I-B. Navy 2 wellfield and power plant erosion control and revegetation measures.

Facility	Site Conditions*					Short-term erosion control	Long-term		Test Measures				
	Surface	Exposure	Test soils	Erosion	Natural reveg.	Barley seeding (lbs/ac)	Spot seed natives	Spread surface soil	Fertilizer	Perimeter fence	Plant protectors	Straw mulch	Brush/cut & native seed
Wellpad 37-17	Cut	NE		-	-		x						
	Fill	NE		-	-	100	x						
Wellpad 63-18	Cut	S		-	-		x						
	Fill	S		-	-	100	x				x		
Wellpad O	Cut	S		-	-		x		Control,				
	Fill	S		-	-	100	x		pads P, 63-18				
Wellpad P	Cut	S	+	-	-		x						
	Fill	S		-	-	100	x			x			
Wellpad U	Cut	S		-	-		x						
(in progress)	Fill	S		-	-			x	test				x
Wellpad R	Cut	N	+				x						
(in progress)	Fill	N				100		x					
Wellpad Y	Cut	S					x		Compare with				
(in progress)	Fill	S				100		x	Wellpad R,U				
Future developments	Cut						x						x
	Fill					100		x	test			x	

*Present site conditions:
Exposure: N=north; S=south; E=east; W=west;
Test soils: "+" indicates physical and chemical testing to be done;
Erosion: "-" indicates erosion hazard not significant; "+" indicates maintenance may be required;
Natural revegetation: "+" indicates natural revegetation is evident; "-" indicates little or no natural revegetation.

Table I-C. BLM 1 wellfield and power plant erosion control and revegetation measures.

Facility	Site Conditions*					Short-term erosion control	Long-term		Test Measures				
	Surface	Exposure	Test soils	Erosion	Natural reveg.	Barley seeding (lbs/ac)	Spot seed natives	Spread surface soil	Fertilizer	Perimeter fence	Plant protectors	Straw mulch	Brush wind
Wellpad A	Cut	S	+	-	-		x		Compare with				
	Fill	S		-	-	100	x		33-19, 73-19				
Wellpad 33-19	Cut	S		-	-		x						
(=C)	Fill	S		-	+		x			x			
Wellpad 72-19	Cut	S		-	-		x						
(=D)	Fill	S	+	+	+	300	in 1989						
Wellpad 73-19	Cut	S		-	-		x						
(=E)	Fill	S	+	-	+		x				x		
Wellpad 46-19	Cut	N		-	-		x						
(=F)	Fill	N		-	+		x						
Wellpad 24-20	Cut	SE		-	-		x						
(=G)	Fill	SE	+	+	-	300	in 1989						
Wellpad P	Cut	S					x						
(in progress)	Fill	S				100		x					
Wellpad Q	Cut	E											
(in progress)	Fill	E				100		x as feasible					
Future devel-	Cut						x						
opments	Fill					100		x	Test			x	X

*Present site conditions:
Exposure: N=north; S=south; E=east; W=west;
Test soils: "+" indicates physical and chemical testing to be done;
Erosion: "-" indicates erosion hazard not significant; "+" indicates maintenance may be required;
Natural revegetation: "+" indicates natural revegetation is evident; "-" indicates little or no natural revegetation.

APPENDIX II. DISCUSSION OF REVEGETATION PRACTICES

SITE PREPARATION

Slope

Within a given soil type, slope is a determining factor for the rate of soil erosion. Although runoff-caused erosion can occur on slopes as gentle as 20 percent (5:1) (Kay and Graves 1983a), soil erosion accelerates with increasing slope. Under experimental rainfall conditions, Kay (1984) found that gravelly sandy loam lost five times more soil from 2:1 slopes than from 5:1 slopes.

The loose soils and unconsolidated parent material at the Coso site rapidly assume their angle of repose, probably about 30 percent, as can be seen from alluvium collecting at the bases of cut slopes. The loose material is an ideal site for plant establishment. Revegetation will take place more rapidly on less steep slopes. Rill erosion is also less severe. The recommendation for future grading is to grade both cut and fill slopes at 2:1 or, preferably, 3:1 slopes whenever feasible. Determination of acceptable slopes will be made on a case-by-case basis.

Cross-drains or contour trenches on fill and cut slopes reduce sheet erosion hazards and provide more favorable sites for plant establishment while presenting little extra graded surface. They reduce the flow and force of water moving downslope, and increase infiltration (Kay and Graves 1983b). They are especially useful in arid lands, and are recommended at this site when feasible.

Surface roughness and other final grading practices. Burgess L. Kay, an authority on revegetation in the Mohave Desert, believes that encouraging natural revegetation is the most economical and effective approach in arid lands (Kay, pers comm., October, 1987). Wind is a natural seed dispersal agent, and a rough surface captures wind-blown seed. Eliminating the final smoothing of graded surfaces encourages seed capture. For slopes already smoothed, "trackwalking" will enhance the effects of natural seedfall (CARCD 1986). Compacted surfaces no longer in use should be ripped to a depth of 18 inches to relieve compaction.

Conserving surface soil. To avoid possible confusion as to whether topsoil (in the usual sense of a discernable surface layer high in organics) actually exists in the Coso region, the term surface soil will be used to refer to the uppermost 4 inches of soil.

An inexpensive source of local seed and beneficial micro-

organisms is surface soil. When surface soil is conserved at the onset of grading operations and spread on unvegetated areas, it can be an effective means of encouraging natural revegetation (Tom Dayak, CalTrans, pers. comm., October, 1987). Lack of oxygen, too much or too little moisture, high temperature or prolonged storage brings loss of seed viability and a reduction in microorganisms (Kay 1987). Spreading surface soil immediately on a completed grade is least damaging to the living portion of the soil. Dust control specifications require that only the uppermost 2 inches of soil may be conserved during initial grading, but it may be spread to greater depth, such as 4 inches.

Mulching. Mulch nearly always shortens the time needed to establish a suitable plant cover (Kay 1978). The benefits of mulch in erosion control and revegetation include:

1) Mulch intercepts raindrops, reducing their erosional force;
2) Some mulches also intercept runoff. This reduces the quantity of soil carried away;
3) Mulches with surface roughness, such as punched straw or gravel, tend to catch and hold wind-carried soil and seed;
4) Many types of mulches encourage water infiltration; and
5) Mulches tend to moderate soil temperatures and retain soil moisture, both critical factors in the arid Mohave Desert.

Available mulching materials include: wood fiber, paper mulch, straw mulch, gravel, hydromulch and chemical stabilizers (Kay and Graves (1983b).

Straw is the recommended mulch material whenever it can be applied (Clary 1983; Kay 1978; Kay and Graves 1983b). The recommended method is punching in 2 to 4 tons/acre in two applications (Bud Kay, pers. comm., November 1987, and Ken Nelson, pers. comm., November 1987). The longest straw has the most stabilizing effect. Rice or other grain straw is better than wild hay because fewer weed seeds are contained. To punch in straw on very steep slopes, a roller must be raised and lowered by a winch (Kay 1978).

In windy sites, straw and other mulches are at risk of blowing away. Chemical stabilizers, or tackifiers, may be used to hold straw in place. However, these are expensive, and are effective only if the straw is well worked into the soil. Another method is broadcast seeding barley or other domesticated grain, which then grows and dies in place, forming a rooted mulch. Since barley is non-persisting in the desert, it does not compete with native species after the first year. The recommended rate is 200-300 lbs/acre alone, or 100 lbs/acre in combination with shrub seed.

For troublesome sites, other types of mulches may be considered. Gravel or rock mulches and jute netting or fiber-

glass mats are highly effective in reducing erosion. While much more expensive than straw mulch (Kay 1978), these alternatives might be considered for small areas.

ADDING PLANT MATERIAL

Spreading surface soil

As indicated earlier, spreading conserved surface soil is a cheap and complete means of re-introducing local seed and microorganisms to newly graded slopes. Surface soil should be spread to a minimum depth of 4 inches as soon as possible after removal from a graded site. It is preferable to move soil between May and December. If initial grading takes place between January and April, most seedlings will be killed, but microorganisms and dormant seed are still of value.

Direct seeding

Several methods may be used for applying seed to soil. Placing seed in, rather than on top of, the soil reduces predation by birds and rodents. Covering seeds by less than 1 cm (0.5 in) encourages maximum emergence (Kay and Graves 1983b). On level ground, the rangeland drill is an ideal tool for applying and covering seed. Rough or steep sites may be seeded by hand, and the seed covered by simply dragging a chain behind a tractor (Clary and Slayback 1984), hand-raking, or allowing the wind to carry in soil to cover (Kay, pers. comm., December 1987).

Where some natural revegetation has already taken place, it is undesirable to disturb the site with mechanical equipment, risking additional erosion. In this case, spot-seeding, a procedure in which a small hole or trench is dug and a small amount of seed is placed just below the soil surface (Chan et al. 1977). This method is advantageous in that it requires very little seed, and can be used any time after final site preparation has taken place.

Hydroseeding, a method in which seeds, wood fiber, water, and fertilizer are sprayed onto bare ground, is generally considered unsuitable for desert applications (Kay 1985; Packer and Aldon 1978; Kay and Graves 1983ba; Clary and Slayback 1984). This method deposits the seeds above ground level. Rainfall followed by a dry spell will cause seeds to germinate, then die from lack of access to soil moisture.

Planting Container Stock

Although using container stock improves establishment and initial rate of growth, the high cost makes it unfeasible to use to any large extent at Coso. A 1977 feasibility study by

Southern California Edison showed that replacing lost desert shrubs with comparable density and species composition of container stock would cost $29,000 per acre; in 1987 dollars, this figure should be doubled, or $55,000 to $60,000 per acre (Dan Pearson, SCE, pers. comm., November, 1987). This figure was corroborated by an estimate that container stock presently costs $4 to $12 per plant installed; and if planted on 3 foot centers, the per-acre cost would be $20,000 to $58,000 (Ken Nelson, pers. comm., November, 1987).

Two species, Joshua trees and creosote bush, both important structural elements in the local vegetation, would benefit from planting as container stock. Due to their high visual impact and importance of Joshua trees to Mohave ground squirrels, small-scale planting of these species is recommended where consistent with surrounding vegetation. This recommendation will be addressed in future annual revegetation plans, as the focus in 1988-89 will be the first-time treatment of a large number of wellpads.

Availability of Seed

Nurseries and seed suppliers specializing in native plants carry a number of plant species indigenous to Coso. However, within-species genetic variation from region to region may be considerable. Custom collection of local seed is ideal. It can be arranged for any quantity of seed and virtually any species; the unit cost decreases with the volume required. Seed can be collected in quantity during productive seed years and stored under controlled conditions, thus reducing cost. The seed collector should report percent live seed.

If custom-collected seed is not available in the quantity required, stocked seed can be used if it has originated from the Mohave Desert from comparable elevation sites.

Which Species Work Best?

In revegetation studies carried out near Little Lake, Clary and Slayback (1984) found *Atriplex polycarpa* was highly successful in direct-seeding trials; its success was attributed to its relative unpalatability to jackrabbits. This species is the principal invading species at Coso as well. 'Marana' fourwing saltbush and *Eriogonum fasciculatum* also performed well in seeding trials at Little Lake. Other species have had limited to poor results, including *Hymenoclea salsola*, *Ephedra nevadensis*, *Larrea tridentata*, and *Oryzopsis hymenoides*. No seeding-trial information is available on *Lycium*, except that Kay *et al*. (1977) found that seed collection was difficult, but the seeds could be germinated and grown.

The choice of species in a seed mix should be determined by

the revegetation objectives, as well as which species are likely to perform well. Atriplex polycarpa should be prominent in the seed mix, since it grows well on disturbed sites, is a major component of surrounding vegetation, and may be of value to the Mohave ground squirrel. Joshua trees should be planted in spot seedings experimentally. All other prominent shrub species should be included in the seed mix if feasible, and their performance evaluated. If erosion control is a persistent problem, use of rabbitbrush (Chrysothamnus nauseosus) should be considered, but it is not desirable. Rabbitbrush comprises an extremely minor part of the local flora and is quite successful and persistent in seedings, thus it might occupy a disproportionate part of the revegetation area.

Grasses have exceptionally good ability to hold surface soil, and are widely used in erosion control. However, annual grasses compete with shrub and forb seedlings and may diminish the success of other efforts. A sparse stand of non-persisting annual grass such as barley is recommended for erosion control and mulch. If barley is used alone, it should be applied at 200-300 lbs/acre. If used in combination with native shrub seed (recommended application rate of 20 lbs/acre or with spot seeding), barley should be applied at 100 lbs/acre.

Timing of revegetation efforts

Direct seeding is most successful in late fall (October-November) (Kay and Graves 1983a). Seeding is best carried out before winter rains but when risk of prolonged drought is minimal. Seeding immediately following grading must be done at any season, but it is preferable to do so during the dry months. Re-treatment may be required to achieve acceptable results.

FOLLOWUP CARE

Irrigation

The prevailing view on irrigation in the desert is that while it may help in the short term, it is of little benefit in the long run. Direct seedings are usually not irrigated. Most authors agree that if the correct species are planted in the fall or early winter and there is normal rainfall afterward, there is no benefit from irrigation (Kay and Graves 1983b).

Tyson (1984) explains the non-irrigation rationale as follows:

> "There is a widespread misconception that a native plant can be planted on any site, irrigated temporarily, and then left to "natural forces". In practice, temporary irrigation commonly produces a larger leaf area than without irrigation. If roots cannot absorb enough water to support the

leaves, the plant will decline or die. There is little or no theoretical or practical justification for temporary irrigation of long-lived vegetation".

Irrigation of revegetation sites is not recommended at this time. In fact, watering for dust control must be taken into account when planning seeding to avoid stimulating seeds at an inappropriate season into germination, as they are likely to perish when the watering ceases. The recommendation here is to seed barley on fill slopes within 24 hours following the final grading and watering.

Fertilizer

Although fertilizer is usually applied with mulch to compensate for nitrogen removed from the soil by decomposition (Kay 1978), this process is very slow in the desert. However, one study (Clary 1983) showed that fertilizing freeway cut slopes in the desert speeded natural re-establishment of indigenous vegetation. This treatment might be tested, since cost is minimal.

Repeating treatments

Any revegetation effort is at the mercy of the weather. Plans should include a contingency for repeated seedings if weather conditions preclude success (Kay and Graves 1983b).

Protection from herbivores

Grazing by herbivores is the single greatest cause of failure of seeded shrubs to survive (Kay and Graves 1983a). Jackrabbits are a common culprit, although rodents also play a role. Wire cages are essential to achieve reasonable success with container stock, and may be helpful in direct seeding as well. The usual wire cage is 3 inches in diameter and 15 inches high. Larger cages are recommended by some (Racin and Dayak 1986), and perforated plastic cages are available which photodegrade in three to five years (Clary 1983). Since poison bait programs or trapping are unacceptable methods of herbivore control, the use of cages should be considered as protection against rodents and jackrabbits.

Wire cages may accelerate establishment of important food plants for the Mohave ground squirrel and help avoid repeated seeding. Their utility will be highest when used selectively on highly palatable species. They should be tested to determine cost-effectiveness.

The wire cages described here are useless against livestock. Until cattle and burros can reliably be kept away, revegetation efforts are at risk.

REFERENCES CITED

California Association of Resource Conservation Districts. 1986. California Interagency seeding guide for erosion control plantings. 6 pp.

California Energy Company. 1987. Plans of utilization and disposal for two 48 megawatt power plants. California Energy Company, Santa Rosa, CA. 36 pages plus attachments.

Chan, Franklin J., Richard W. Harris, and Andrew Leiser. 1977. Direct seeding woody plants in the landscape. University of California Agricultural Extension Leaflet 2577. 12 pp.

Clary, Raimond F., Jr. 1983. Planting techniques and materials for revegetation of California roadsides. U.S. Dept. of Agriculture, Soil Conservation Service, Lockeford, CA. 161 pp.

Clary and Slayback 1984. Revegetation in the Mojave Desert using native woody plants. In: Proceedings of the symposium on native plant revegetation, November 15, 1987, San Diego, CA. pp.42-47.

Kay, Burgess L. 1978. Mulches for erosion control and plant establishment on disturbed sites. University of California Agronomy Progress Report No. 87. University of California, Davis. 19 pp.

_____. 1979. Summary of revegetation attempts on the second Los Angeles aqueduct. Mohave Desert Revegetation Note No. 22. University of California, Davis, Department of Agronomy and Range Science. 24 pp.

_____. 1984. Cost and effectiveness of mulching practices. In: Proceedings of the Sixth High Altitude Revegetation Workshop, Colorado State University, Ft. Collins,. CO, March 5-6, 1984. 12 pp.

_____. 1985. Important revegetation concepts with emphasis on the Mohave-Tehachapi area. 7 pp.

_____. 1987. Considerations in revegetation planning. California Geology. January 1987. pp. 7-9.

_____ and Walter Graves. 1983a. Revegetation and stabilization techniques for disturbed desert revegetation. Chapter 17 in Environmental Effects of Off-Road Vehicles, Impacts and Management in Arid Regions. Webb, R.H. and H.G. Wilshire (eds.). Springer-Verlag. 534 pp.

_____. 1983 b. History of revegetation studies in the California deserts. Chapter 16 in Environmental Effects of

Off-Road Vehicles, Impacts and Management in Arid Regions. Webb, R.H. and H.G. Wilshire (eds.). Springer-Verlag. 534 pp.

Kay, Burgess L., Catherine M. Ross, and Walter Graves. 1977. Mojave revegetation notes. University of California Cooperative Extension, Davis. (Twenty-one separate monographs of 2-10 pages each).

Packer, P.E. and E.F. Aldon. 1978. Revegetation techniques for dry regions. In: M. Stelly (ed.), Reclamation of drastically disturbed lands. American Society of Agronomy, pp. 425-450.

Racin, James A. and Tom Dayak. 1986. Revegetation of highway slopes in the high desert with native plant seedlings: interim report. California Department of Transportation, Sacramento, CA. 56 pp.

Tyson, Wayne. 1984. Revegetation by objectives. Proceedings from the conference on revegetation, San Diego,. CA. pp 10-14.

Use the Bookmark Feature in Acrobat to return to Main Menu

APPENDIX H

Hydrology and Water Quality, Section 3.2 and Appendix C of Draft EIR

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3.2 Hydrology and Water Quality

3.2.1 ENVIRONMENTAL SETTING

Overview

Project Area

The proposed project includes groundwater pumping from wells located in Rose Valley, which is situated in the southeastern California desert. The project area is shown in Figure 1.1-1. The project also includes installation of 9 miles of pipeline for delivery of the pumped groundwater to the Coso geothermal field in the Coso Range, east of the Rose Valley.

The project area lies within an arid desert region that receives about 6 inches of precipitation per year. Surface water is limited; however, the alluvial valley includes a groundwater aquifer that is recharged from precipitation in various surrounding sources, including the Sierra Nevada Mountains.

This section of the EIR includes a description of the existing surface water and groundwater resources and water quality in the project area and region. The geothermal resource on CLNAWS is also described.

Methods

The assessment of surface water and groundwater hydrology and water quality presented in this section is based on several previously prepared studies and reports, as well as studies performed specifically for the proposed project.

Existing Reports and Studies. Many sources of information on local and regional hydrology and geohydrology have been referenced and used in preparation of this hydrology section. The primary sources include:

- *The Hydrology of the Rose Valley and Little Lake Ranch, Inyo County, California* (Bauer 2002). This report includes a detailed analysis of the hydrology of Little Lake, a perennial lake with surrounding ponds, located about 9 miles south of the proposed project site. The report includes research and results of survey work at the lake to characterize the groundwater system in the area. Data and analysis pertaining to the understanding of the hydrology of the groundwater systems in Rose Valley and in particular, Little Lake, have been incorporated in this section of the EIR.
- *Hydrogeologic and Hydrochemcial Framework of Indian Wells Valley, California: Evidence for Interbasin Flow in the Southern Sierra Nevada* (Williams 2004). This report describes the geohydrologic characteristics of the Indian Wells Valley, which is directly south of the Rose Valley. It also includes data on groundwater chemistry and chemical isotope analysis for water flowing into Indian Wells Valley, including from the Rose Valley. Data on chemical isotope sourcing for water in Little Lake are included in this report and were used in the setting and analysis of this EIR section.

Consultants for the Coso Operating Company (COC) previously performed groundwater testing and modeling for the proposed project. These studies have been reviewed and used as appropriate to describe the setting and to analyze the project impacts. The reports on the previous groundwater modeling efforts include:

- *Results of Aquifer Tests, Hay Ranch Production Wells, Rose Valley, Coso Junction, California* (GeoTrans 2003). Pumping tests were conducted in 2003 by GeoTrans using the two Hay Ranch production wells. The aquifer tests consisted of: 1) pumping the south Hay Ranch well at a rate of approximately 2,006 gpm for 24 hours beginning on

September 10, 2003, followed by recovery monitoring for a period of 29 hours; and, 2) pumping the north Hay Ranch well at a rate of approximately 2,040 gpm for 24 hours beginning on September 13, 2003 followed by recovery monitoring for a period of approximately 21 hours.

- *Rose Valley Groundwater Model* (Brown and Caldwell 2006). This report describes the initial groundwater model prepared for the Hay Ranch project. The consulting firm Brown and Caldwell was retained by COC to develop a groundwater flow model for the Rose Valley groundwater basin. The model was based on data and interpretations from previous studies and compilations of available geological, geophysical, and hydrological data. The groundwater flow system was defined, flow components identified, and the magnitude of each was estimated in this report. A conceptual water budget was then established. Upon completion of the conceptual model, a three-dimensional numerical groundwater flow model for the Rose Valley was developed using MODFLOW (McDonald and Harbaugh 1988). The model was first calibrated by simulating the steady-state groundwater system conditions in the Rose Valley and then used in a predictive mode to assess the potential impact of the proposed project's groundwater withdrawal on the Rose Valley's subsurface flow system.

The description and analysis of the geothermal resource and Coso Hot Springs are based on several documents, including:

1) Coso Hot Springs Monitoring Report (Geologica 2004-2007)
2) Hydrological Analysis of the Coso Geothermal System: Technical Summary (ITSI 2007)
3) Geologic History of the Coso Geothermal System (Adams et al. June, 2000)

Additional Studies Performed for the Proposed Project. Additional studies were conducted to analyze the project effects as a part of this EIR process, including:

1) A groundwater pumping test on the proposed water supply wells for the project to supplement the data gathered during the pumping test performed in 2003 by GeoTrans
2) A recalibration of the Brown and Caldwell (2006) MODFLOW model
3) Testing and analysis of water isotope, chemistry, and drinking water quality

Several issues were identified with the performance and analysis of the 2003 pumping tests, including the issue that only the two wells on the Hay Ranch property were monitored during the pumping test, that the test duration was limited to 24 hours, and that the groundwater levels in the Hay Ranch wells had not fully recovered to their pre-pumping levels from the testing of the south well when the north well testing began. Review of the data collected in the testing of the south well suggests that the aquifer continued to recover from the testing of the south well during the entire duration of the testing of the north well. As a result, data from testing of the north well could not be evaluated reliably using the graphical methods presented in the GeoTrans (2003) report.

To address these deficiencies, a long term pumping test was performed and analyzed for this EIR in order to:

1) Produce additional data that allowed better definition of the existing groundwater reservoir and better calibration of the numerical model;
2) Provide a basis for more defensible forecasts of long term aquifer behavior using the numerical model (better impact analysis); and
3) Provide data to use in the numerical model to develop monitoring and mitigation measures such as "trigger levels" and monitoring locations.

The pumping test was performed over a period of 20 days from November 17, 2007 to December 6, 2007. The pumping test report is included in Appendix C1. The test included installing a temporary

pump in the existing Hay Ranch south well, pumping groundwater at a rate of approximately 2,000 gallons per minute for a period of 14 days, and monitoring groundwater levels at various locations throughout Rose Valley for 20 days. The groundwater level monitoring program consisted of a combination of long term and short term monitoring conducted before, during, and after the pumping test, depending on well access and operational constraints. COC utilized existing agriculture and drinking water supply wells owned by various parties, including COC, for pumping test monitoring. No new wells were constructed for the test. The locations of the monitoring wells and the results of the test are presented in Appendix C1.

Results of the pumping tests were then used to recalibrate the Brown and Caldwell (2006) MODFLOW groundwater flow model to:

- Evaluate groundwater conditions;
- Analyze the potential impacts to groundwater resources in Rose Valley; and
- Define mitigation measures to reduce potentially significant effects of the construction and operation of the proposed COC Hay Ranch project.

The model recalibration process and application of the model to impact analysis are described in Appendix C2.

In addition to compiling and integrating available water chemistry and isotope data from Rose Valley waters into a database, six water samples were collected and analyzed to help understand the groundwater flow system. Samples from the Hay Ranch south well, Coso Junction #2 well, Davis Spring at Portuguese Bench, Little Lake north well, and Coso Spring were analyzed for stable isotopes of oxygen and hydrogen in water (oxygen-18 and deuterium) at Isotech Laboratories. Chloride, boron and total dissolved solids were analyzed at Zalco Laboratories. One sample from the Hay Ranch south well was collected by COC and analyzed for drinking water standard analytes (inorganic and general chemical) at Zalco Laboratories.

Climate and Physiography

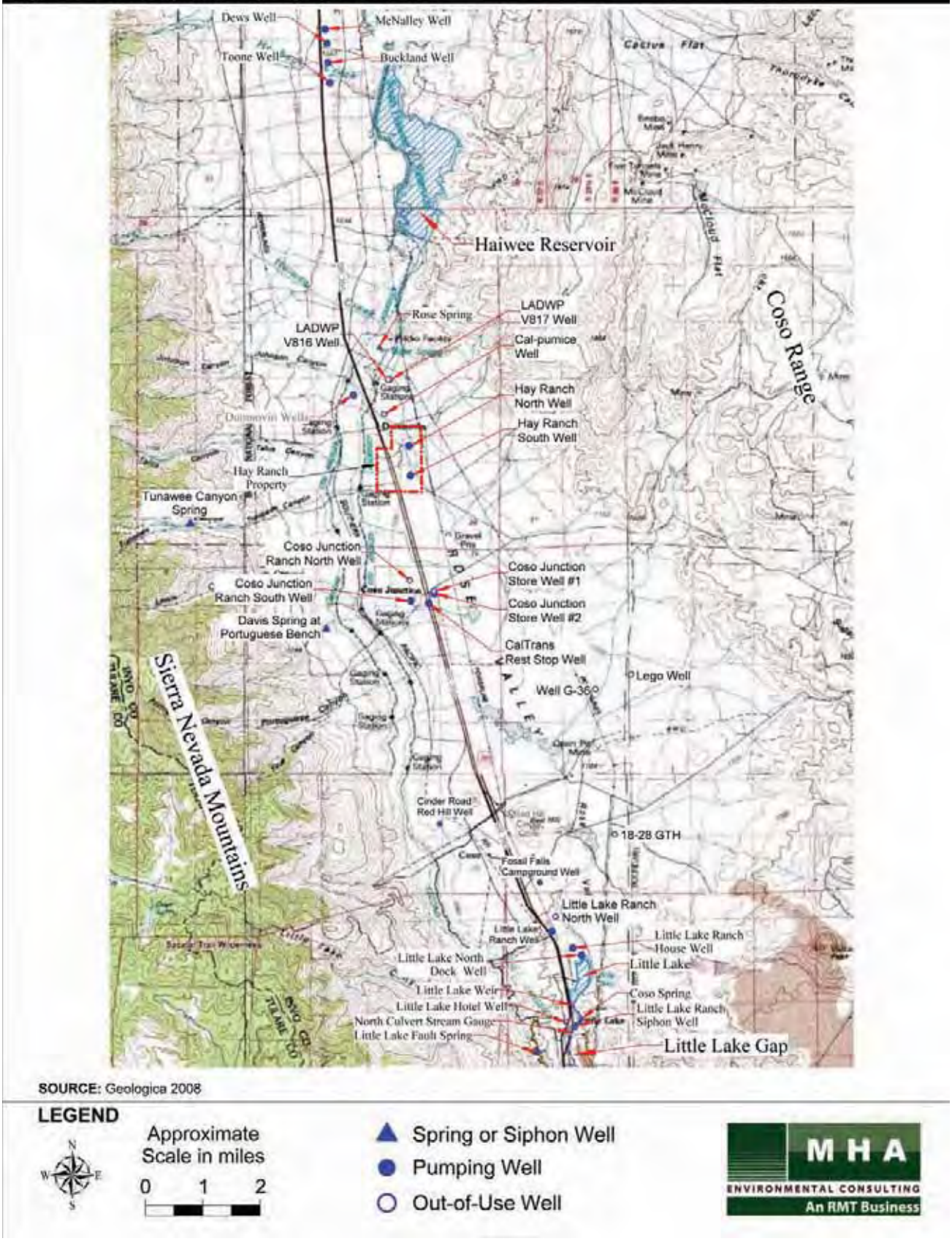
Rose Valley is a long, narrow valley located on the eastern flank of the Sierra Nevada Mountains in Inyo County, California. The ground surface of the valley floor slopes gently to the south at a rate of 30 to 35 feet per mile. The alluvial portion of the groundwater basin is approximately 16 miles long from the southern end of the Haiwee Reservoir to just south of Little Lake and has a maximum width of approximately 6 miles at its widest point. Rose Valley is topographically separated from the Owens Valley (north of Rose Valley) by Dunmovin Hill, a topographic high that is composed of a massive landslide or series of debris flow deposits that originated from the Sierra Nevada range to the west (Bauer 2002). Rose Valley is separated from the Indian Wells Valley (south of Rose Valley) by a topographic high formed by a combination of granitic rocks and volcanic flows, and by the Little Lake Gap, which is an approximately 1,000 feet wide water-carved canyon incised within the volcanic bedrock (Bauer 2002). Figure 3.2-1 shows the physiographic features of the project area.

The average annual precipitation in Rose Valley ranges from 5 to 7 inches, while the area's open potential water evaporation rate has been estimated to be up to 65 to 80 inches per year (CWRCB 1993, Bauer, 2002). Evapotranspiration rates for soil and plants in the area are likely lower, based on investigations conducted in Owens Valley (Steinwand et al. 2006). Surface water bodies in the Rose Valley area consist of perennial springs sustained by groundwater flow, ephemeral streams and washes that mainly flow in the winter, and manmade lakes and reservoirs.

Surface Water

Surface water features of interest are shown on Figure 3.2-1. The principal surface water bodies in Rose Valley include:

Figure 3.2-1: Study Area Physiographic Features



SOURCE: Geologica 2008

LEGEND

Approximate Scale in miles

0 1 2

▲ Spring or Siphon Well

● Pumping Well

○ Out-of-Use Well

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- South Haiwee Reservoir
- Several springs
- Little Lake and its associated springs, wetlands and ponds

Haiwee Reservoir

South Haiwee Reservoir is located at the north end of Rose Valley approximately 4 miles north of Hay Ranch (shown in Figure 3.2-1). The Los Angeles Department of Water and Power (LADWP) owns and operates Haiwee Reservoir as part of the Los Angeles Aqueduct system, which supplies drinking water to the Los Angeles area.

The crest of south Haiwee Dam is located at approximately 3,766 feet above mean sea level (amsl). Because of seismic stability concerns, the water level in the reservoir is currently limited to a maximum elevation 3,742 feet amsl. The water level in the reservoir typically rises during the winter rainy season. During a month-long period that included the Hay Ranch pumping test described in Appendix C1, the water level in the reservoir rose approximately 4 feet, from approximately 3,722 feet on November 1 to 3,726 feet on December 5, 2007.

Springs

Several springs are located in Rose Valley, including (Bauer 2002):

- Rose Spring located near Haiwee Reservoir
- Tunawee Canyon Spring
- Davis Spring located at Portuguese Bench
- Little Lake Fault Spring
- Coso Spring

Rose Spring is located approximately 2 miles south and west of the South Haiwee Reservoir. The spring is located at an elevation of approximately 3,600 feet amsl. Rose Spring is located on an east-facing slope above a wash. A concrete storage structure lies below the spring. Water pipes from the spring once fed the storage structure, but the piping system is no longer functional. No surface water was present during a biological reconnaissance survey conducted on April 5, 2008.

Tunawee Canyon Spring is located in Tunawee Canyon approximately 4 miles west and north of Coso Junction at an approximate elevation of 5,200 feet amsl. Several springs are identified in the upper reaches of Tunawee Canyon on the USGS topographic map of the area. The spring is likely sustained by high elevation precipitation infiltration in the Sierra Nevada Mountains to the west. No information regarding discharge rates from the spring was identified.

The Davis spring is located on the Davis Ranch, approximately 2 miles southwest of the Hay Ranch property. The Davis spring is located on the west-central side of Rose Valley at Portuguese Bench at an elevation of approximately 3,870 feet amsl. The groundwater discharge rate from the Davis spring, referred to as the Davis siphon well in Appendix C1, was measured during the November/December 2007 pumping test and ranged from 4.2 to 4.5 gallons per minute (gpm), or approximately 7 acre-feet/yr.

The Davis spring discharge is located more than 600 feet higher than the groundwater table in the Rose Valley aquifer east of the Davis property at Coso Junction. Spring flow is sustained by high elevation precipitation infiltration in the Sierra Nevada Mountains west of the Davis property. Monitoring of the spring discharge rate during the 2007 pumping test did not provide any evidence of impacts from pumping at Hay Ranch, based on spring flow measurements made at the time. Discharge from the spring that is not used on the Davis property infiltrates back into the ground and percolates downward to recharge the alluvial aquifer.

The Little Lake Fault Spring and Coso Spring are located at the south end of Rose Valley. Little Lake Fault Spring is located on the west side of Highway 395, approximately 1 mile south of Little Lake. Coso Spring is located on the east side of Highway 395, on the Little Lake Ranch property, approximately 0.25 miles south of Little Lake. No data have been identified regarding the groundwater discharge rate from the Little Lake Fault Spring. The Little Lake Fault Spring and Coso Spring are discussed further under the heading “Little Lake.”

Little Lake

Overview of Little Lake Surface Water Features. Little Lake is a man-made perennial lake located at the south end of Rose Valley approximately 9 miles south of the Hay Ranch property (Figures 3.2-1 and 3.2-2). Little Lake is located entirely within the Little Lake Ranch, which is a 1,200 acre privately-owned recreational preserve owned and managed by Little Lake Ranch, Inc.

A habitat restoration and improvement plan for Little Lake was prepared and approved on October 14, 2000. The plan included several wetland enhancement plans. A copy of the plan and the associated Mitigated Negative Declaration are included in Appendix E of this EIR.

The wetlands, riparian zone (interface between land and surface water), and open water habitat on the property currently include the 90-acre Little Lake, two perennial ponds (P-1 and P-2 on Figure 3.2-2), several other ponds that reportedly contain water intermittently, and adjacent wetland habitat. Little Lake is reportedly 3 to 5 feet deep; the depths of the other ponds are unknown. The configuration of ponds, springs, and wells at the Little Lake property are shown in Figure 3.2-2.

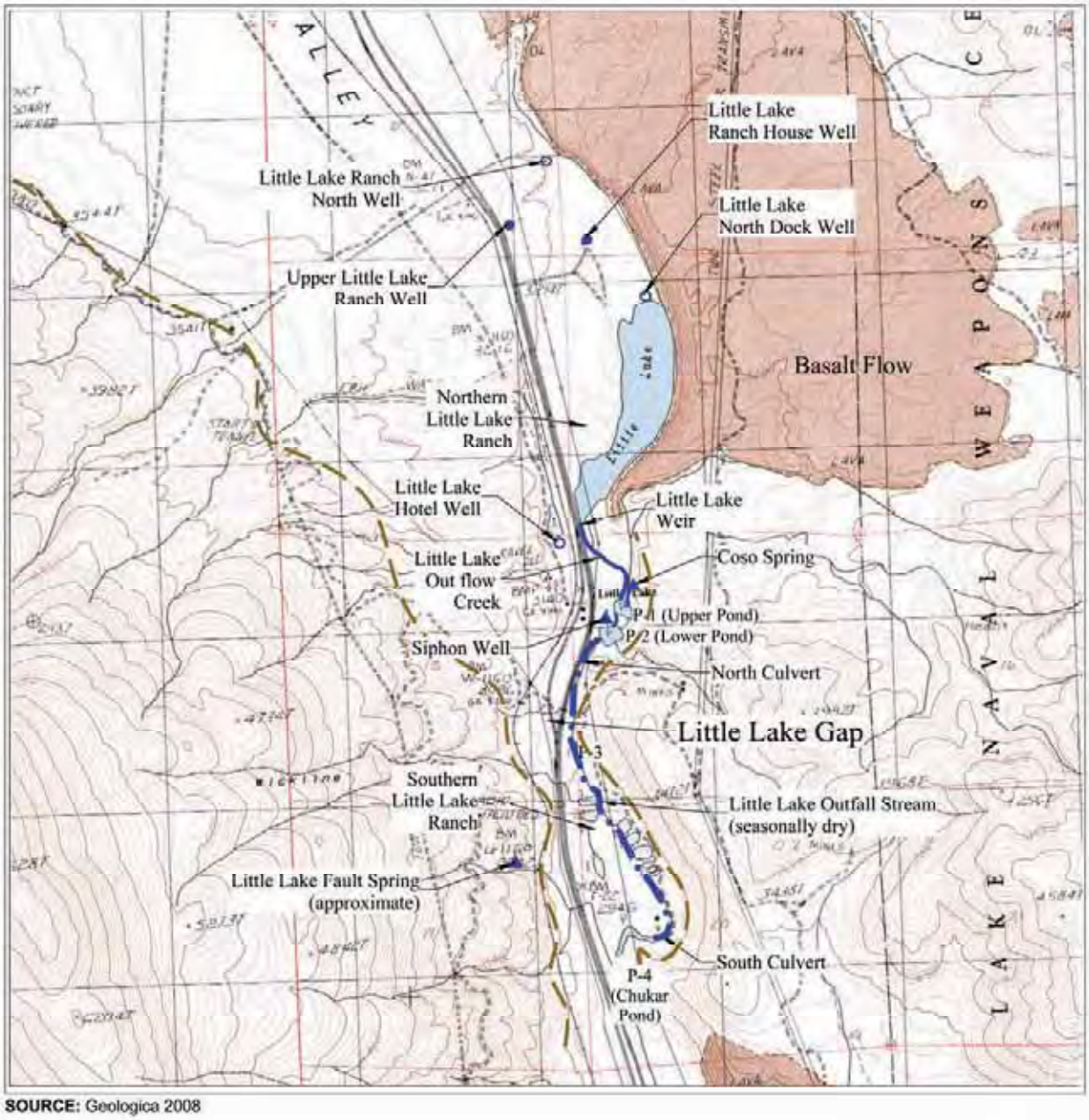
Little Lake and the surrounding wetland areas and ponds are fed by a combination of groundwater, submerged springs, and surface springs. At the southern end of Rose Valley, groundwater flow through the Little Lake Gap is constrained by bedrock on the east and west and an apparent subsurface bedrock rise below. The ground surface in the area slopes gently to the south between the northern property line and Little Lake, then more steeply south of Little Lake. As a result of the combination of south-sloping ground surface and bedrock barriers to lateral or vertical groundwater flow, groundwater in this area discharges to the surface. Some wetlands occur here naturally; however, the system is now manipulated for maintenance of the lake for recreational purposes and habitat enhancement efforts.

The only groundwater level data identified for the Little Lake Ranch property, collected in 1997 and 1998 (Bauer 2002), indicated that the groundwater elevation at the north end of the lake was approximately 3 feet higher than the lake level and that the lake gains water from the aquifer. Overflow from the Little Lake weir at the south end of the lake is conveyed to Upper Little Lake Pond (P-1) through an open channel.

Groundwater discharging from the Coso Spring, located approximately 0.25 miles south of Little Lake, also flows into Upper Little Lake Pond (P-1). A siphon well located south of Little Lake (below the elevation of Little Lake and Coso Spring) brings additional groundwater to the surface where it is piped to Lower Little Lake Pond (P-2). The discharge from both ponds flows through an open channel to the south where it is used to fill additional ponds when flow is adequate. No surface water flows off the Little Lake Ranch property (ULLR 2000).

The siphon well consists of a short vertical well screen and a 12-inch diameter discharge pipe. As long as the discharge pipe is full of water (“primed”), the pipe suctions groundwater from the vertical well screen. Little Lake Ranch staff can raise or lower the weir on Little Lake to control the discharge rate when the lake level is high enough to sustain discharge. Water usually does not flow from the lake in the summer and early fall months. There is no provision to manipulate the discharge rate from Coso Spring or the siphon well; both flow in accord with prevailing groundwater conditions. The flow rates of these features are not monitored and the elevations and locations of surface water features at Little Lake have not been surveyed.

Figure 3.2-2: Hydrologic Features of Little Lake Ranch



SOURCE: Geologica 2008

LEGEND

Scale in miles

0 0.5

▲ Spring or Siphon Well

● Pumping Well

○ Out-of-Use Well

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Relationship Between Groundwater Elevation, Lake Level, and Discharge Rate. Monitoring data collected by Bauer (2002) for a 14-month period between January 6, 1997 and March 21, 1998 provides some insight into the hydrologic system operating at Little Lake. These data are summarized in Table 3.2-1 and schematically illustrated on Figure 3.2-3. Bauer (2002) observed that the groundwater elevation in a monitoring well immediately north of Little Lake (now known as the Little Lake North Dock well) was consistently 3 feet higher than the lake level (see Figure 3.2-3) indicating that the lake gained water from the aquifer throughout the year (Bauer 2002). This elevation difference is maintained by a combination of evaporation from the lake surface, which removes water from the system, and discharge over the weir, which allows the water to flow south to lower elevation ponds on the property (otherwise the lake would equilibrate at the same level as the aquifer). As a result of habitat restoration efforts by Little Lake Ranch, some features, such as the configuration of the Little Lake weir, may differ from those observed by Bauer in 1997/1998.

As illustrated on Figure 3.2-4, groundwater level monitoring conducted by COC indicates that groundwater elevations have risen by approximately 2 feet in the last five years (since 2003) throughout the northern part of Rose Valley. The impact of the rising groundwater table on lake levels and discharge rates has not been documented but higher lake levels and higher discharge rates are likely.

Groundwater

Hydrostratigraphic Units

Hydrostratigraphic units are the geologic formations in which groundwater flows. The principal hydrostratigraphic units that comprise the Rose Valley aquifer are recent alluvial deposits and the Coso Lake Bed and Coso Sand Members of the Coso Formation. Older bedrock has much lower permeability and greatly impedes or excludes groundwater flow.

Groundwater Occurrence and Flow

The groundwater table in the Rose Valley project area ranges from 140 to 240 feet below ground surface (bgs) in the northern and central parts of Rose Valley to approximately 40 feet bgs at the northern end of the Little Lake Ranch property, near the southern end of the valley. A groundwater elevation contour map of Rose Valley, developed from depth to water measurements made on November 19, 2007, is presented on Figure 3.2-4 and tabulated in Table 3.2-2.

Groundwater generally flows to the southwest in the valley as evidenced during the pumping test conducted in November 2007. With one exception, the November 2007 monitoring results were consistent with observations reported by Bauer (2002) for data collected in 1998 for valley groundwater. Water level measurements in Navy well 18-28, located in southeastern Rose Valley (Figure 3.2-5), indicated that the groundwater elevation in this area was approximately 10 feet higher than expected. This well was not available for monitoring during previous investigations. The higher groundwater elevation is believed to be the result of impeded groundwater flow through the volcanic deposits south of the Red Hill cinder cone, towards Little Lake, and/or groundwater inflow from the Coso Basin to the northeast.

Because the ground surface slopes more steeply to the south of Rose Valley than the groundwater table, the groundwater table surfaces from springs beneath Little Lake, sustaining the lake and the surface water discharge across the Little Lake weir. Additional groundwater discharges from Coso Spring and the Little Lake Ranch siphon well as the ground surface dips more steeply to the south, south of Little Lake.

Table 3.2-1: Rose Valley EIR -Summary of Bauer (2002) Stream and Spring Flow Measurements

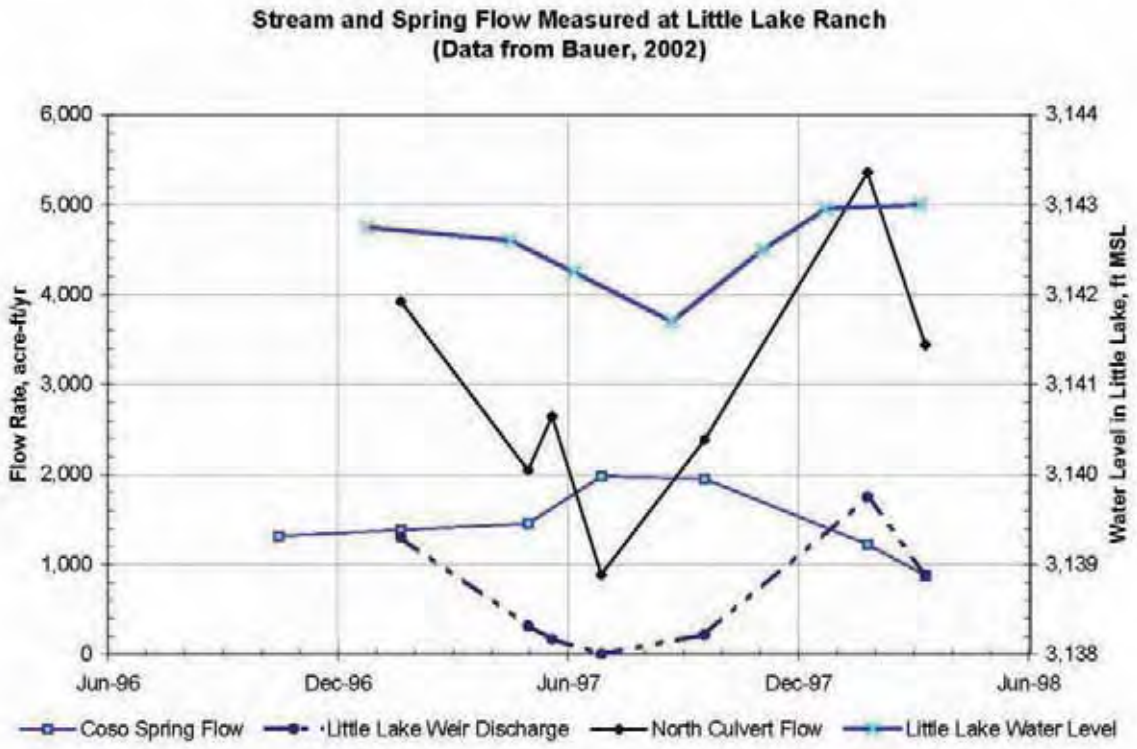
Location	Date Measured	Flow Rate, acre-ft/yr
Coso Spring	10/28/96	1,311
South Culvert (1)	10/28/96	318
Coso Spring	2/2/97	1,382
Little Lake Weir	2/2/97	1,299
North Culvert (2)	2/2/97	3,924
South Culvert	2/2/97	515
Coso Spring	5/14/97	1,451
Little Lake Weir	5/14/97	312
North Culvert	5/14/97	2,043
South Culvert	5/14/97	583
Little Lake Weir	6/2/97	166
North Culvert	6/2/97	2,646
South Culvert	6/2/97	676
Coso Spring	7/11/97	1,976
Little Lake Weir	7/11/97	0
North Culvert	7/11/97	885
South Culvert	7/11/97	428
Coso Spring	10/1/97	1,949
Little Lake Weir	10/1/97	217
North Culvert	10/1/97	2,384
South Culvert	10/1/97	627
Coso Spring	2/7/98	1,222
Little Lake Weir	2/7/98	1,746
North Culvert	2/7/98	5,357
South Culvert	2/7/98	1,866
Coso Spring	3/25/98	874
Little Lake Weir	3/25/98	887
North Culvert	3/25/98	3,439
South Culvert	3/25/98	917

NOTES:

(1) Most southerly surface water flow on the property.

(2) Flow rate in ditch discharging from lower Little Lake pond (P-2); should contain combined flow from Little Lake Weir, Coso Spring, and Siphon well.

Figure 3.2-3: Flow and Water Level Measurements at Little Lake



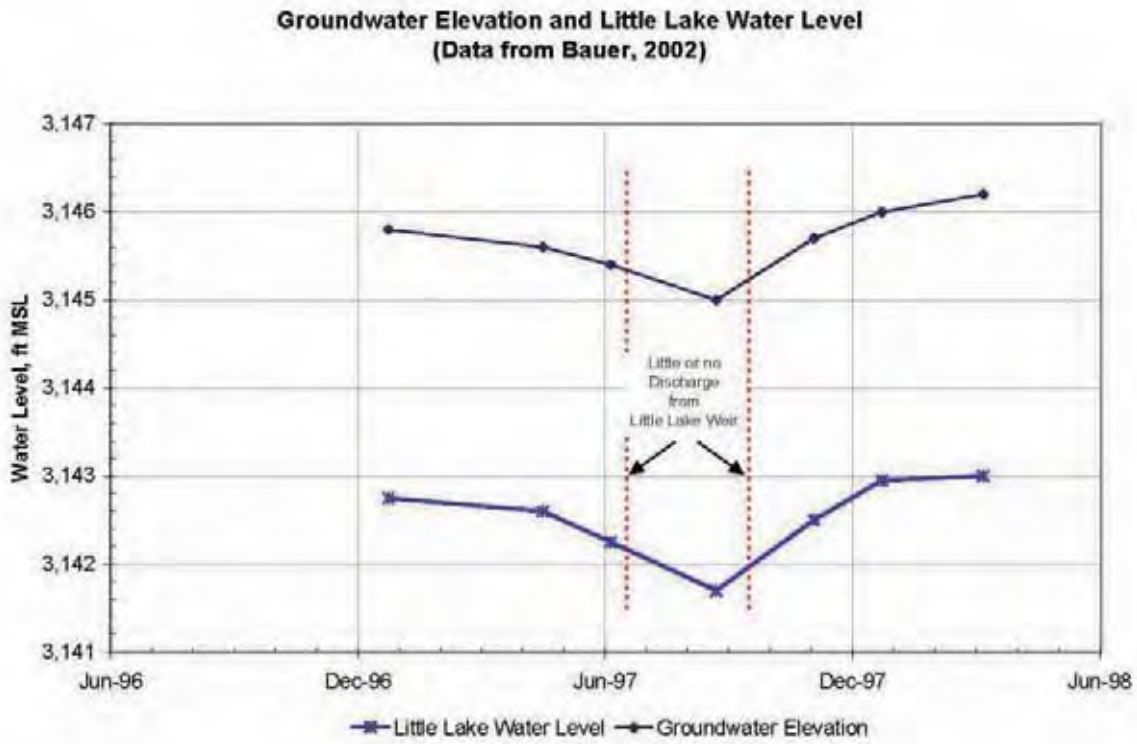
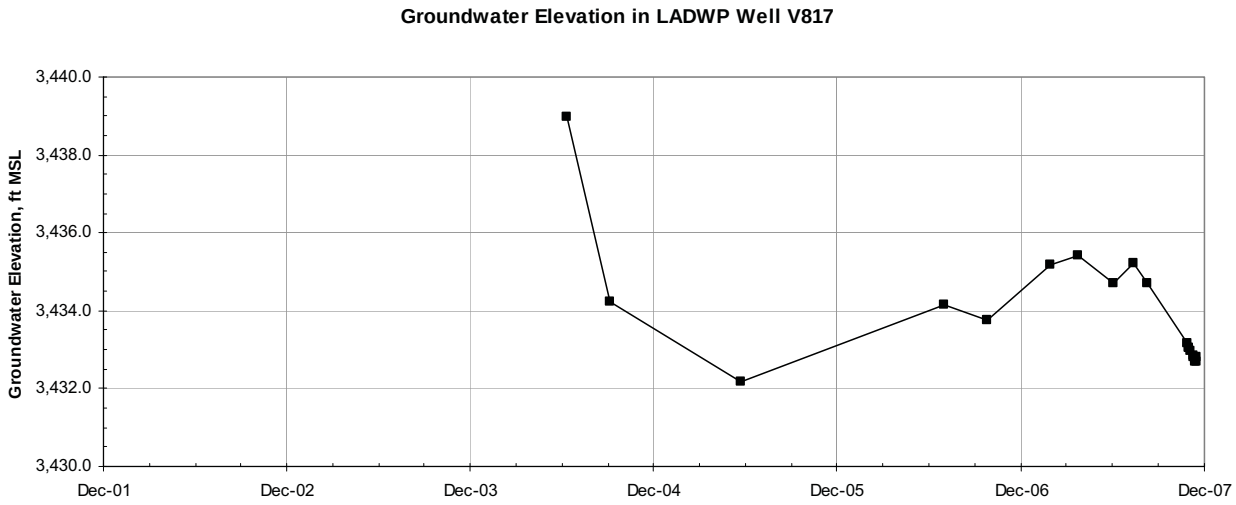
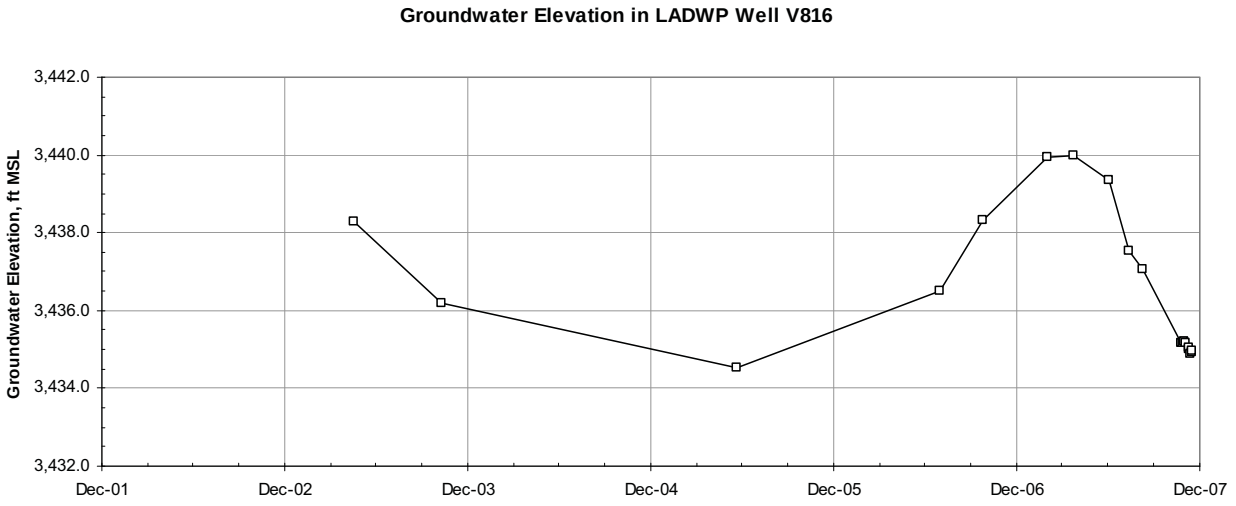


Figure 3.2-4: Groundwater Elevation Hydrographs





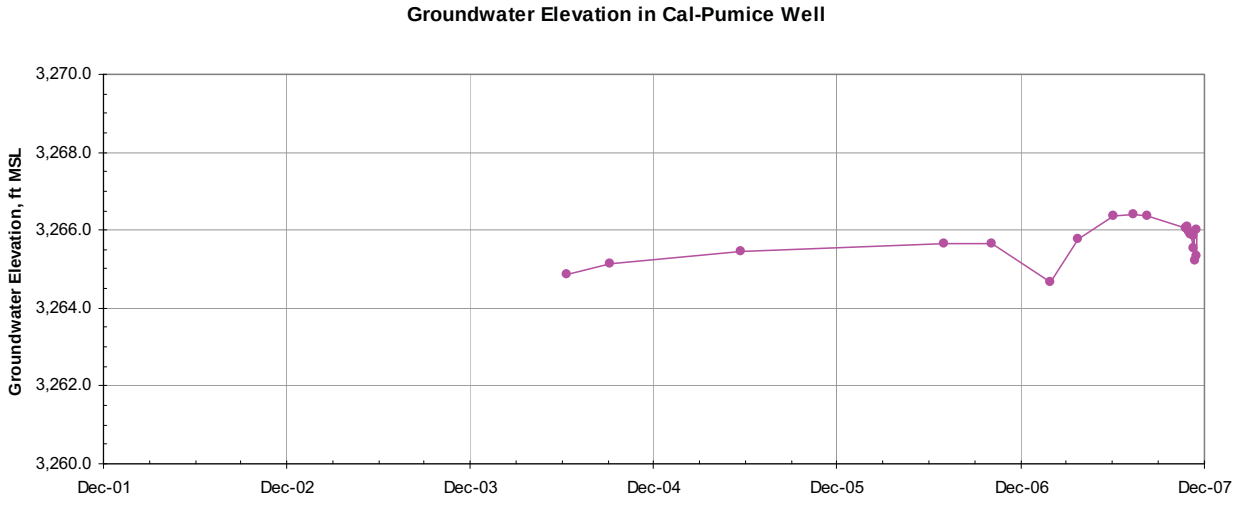
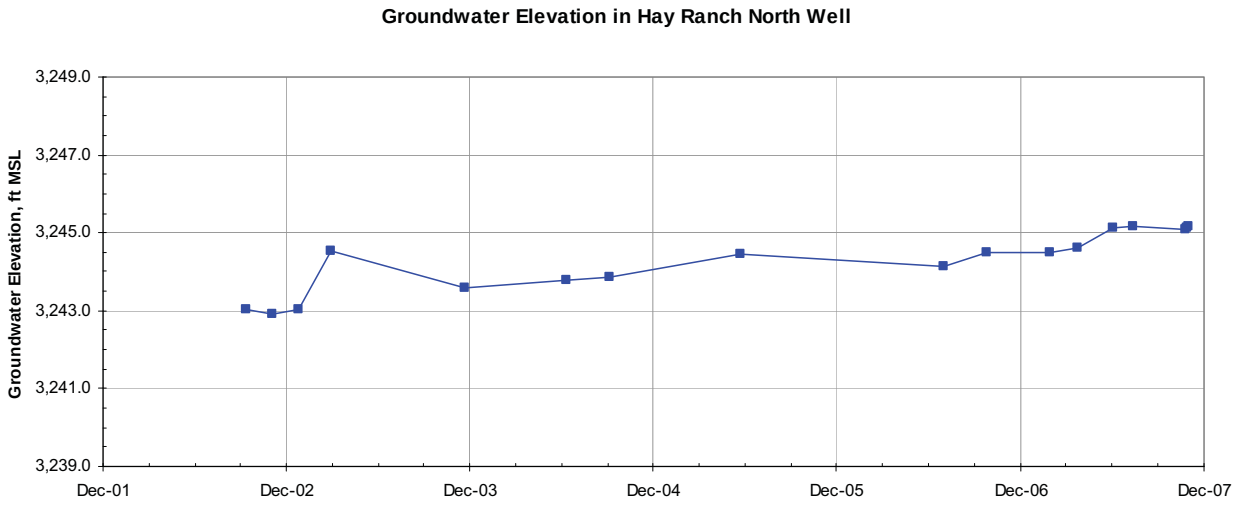
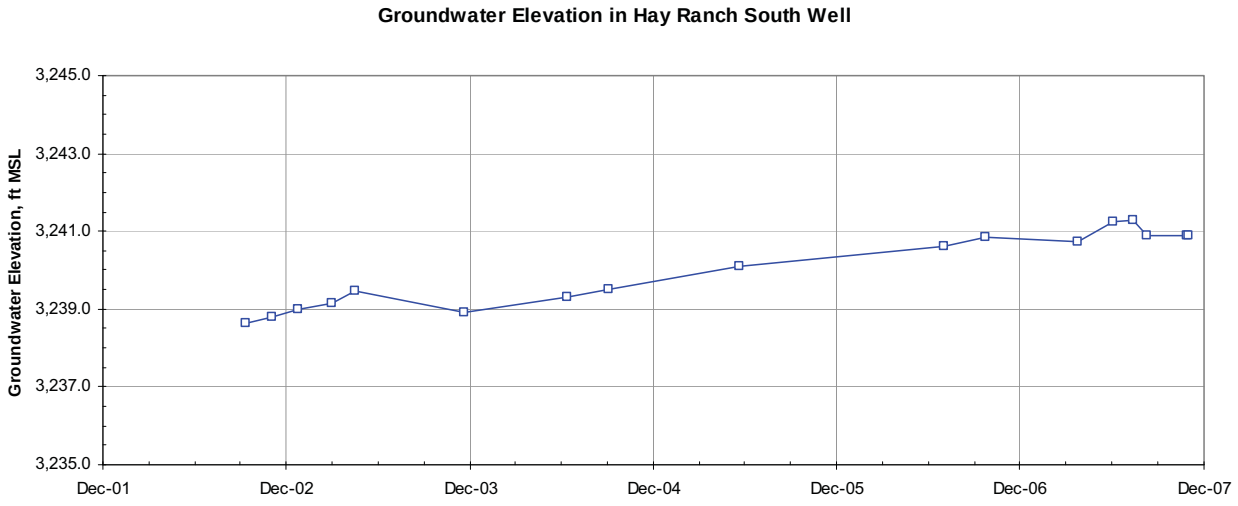


Figure 3.2-4 *(Continued)*: Groundwater Elevation Hydrographs





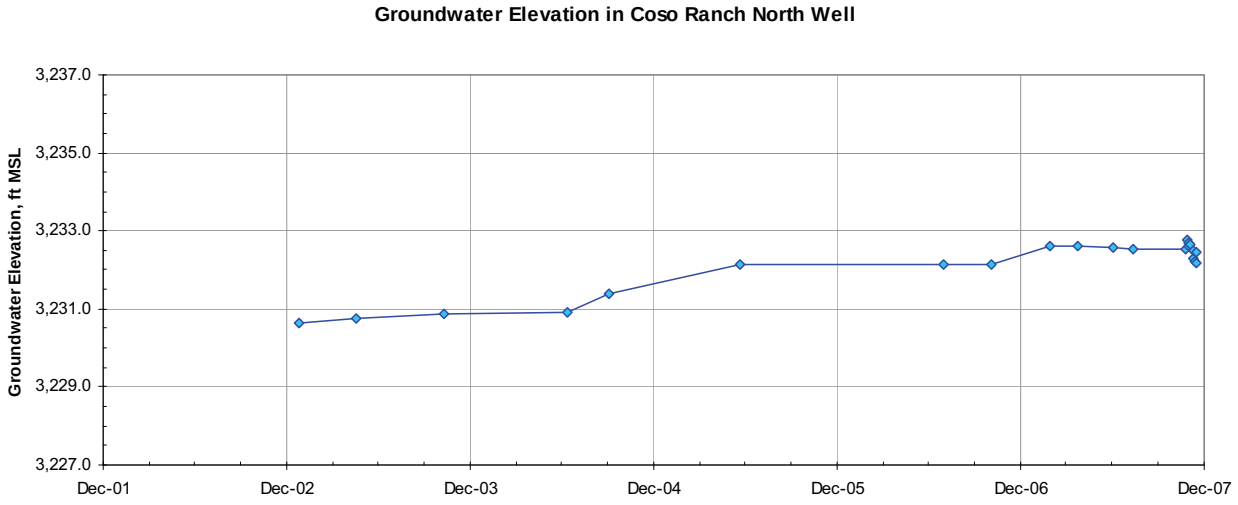
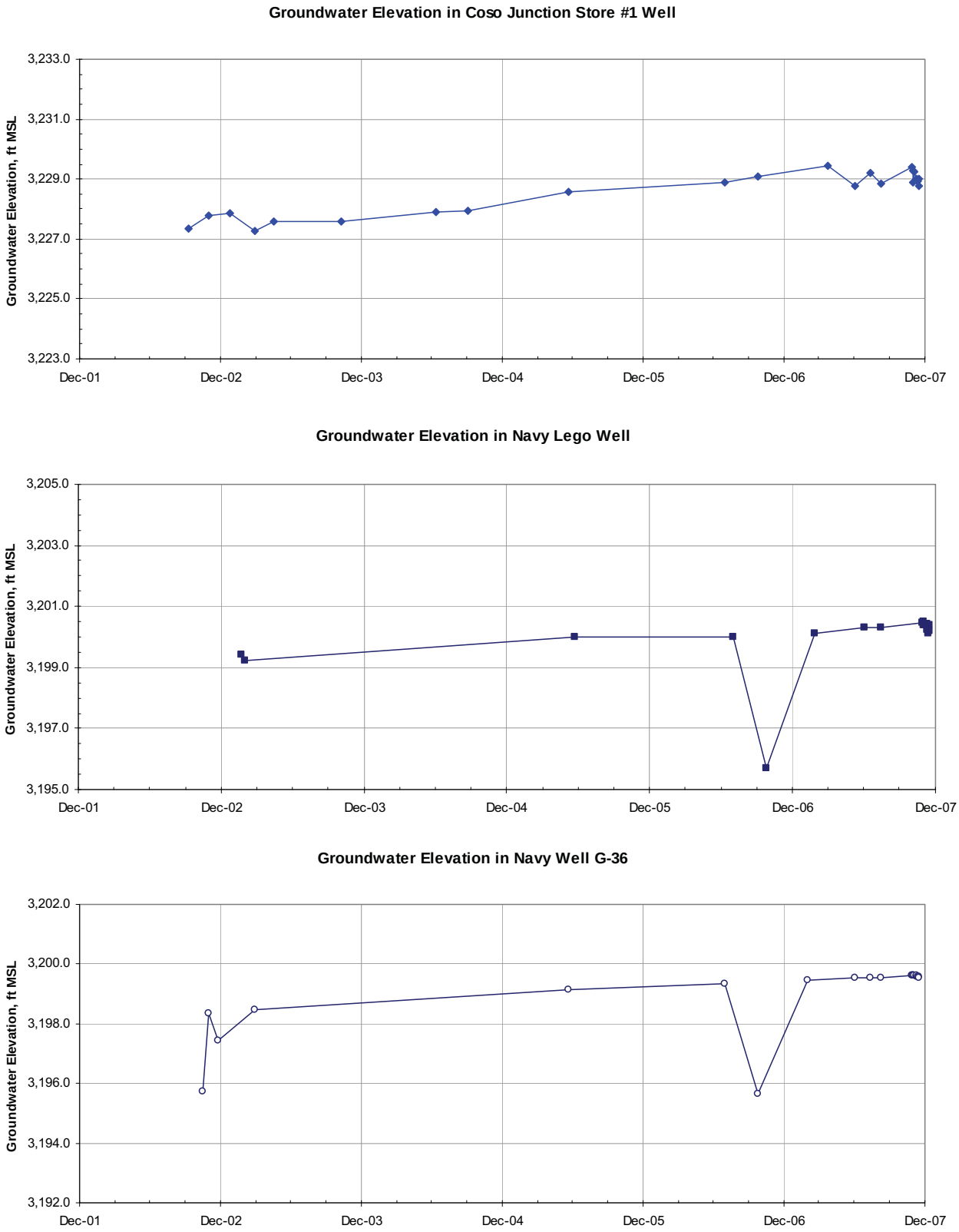


Figure 3.2-4 *(Continued)*: Groundwater Elevation Hydrographs



SOURCE: Geologica 2008

Table 3.2-2: Rose Valley EIR November 2007 Groundwater Elevation Data

Well	Reference Point Elevation, ft MSL	Depth to Groundwater, ft	Groundwater Elevation, ft MSL
LADWP V816	3,515.35	80.15	3,435.20
LADWP V817	3,511.86	78.86	3,433.00
Cal-Pumice	3,506.38	240.38	3,266.00
Hay Ranch North	3,436.78	191.78	3,245.00
Hay Ranch South	3,420.25	179.35	3,240.90
Coso Junction Store #1	3,372.10	142.80	3,229.30
Coso Ranch North	3,402.72	170.02	3,232.70
G-36	3,379.85	180.25	3,199.60
Lego	3,422.81	222.31	3,200.50
18-28 GTH	3,362.62	174.42	3,188.20
Little Lake Ranch North	3,199.15	40.20	3,158.95

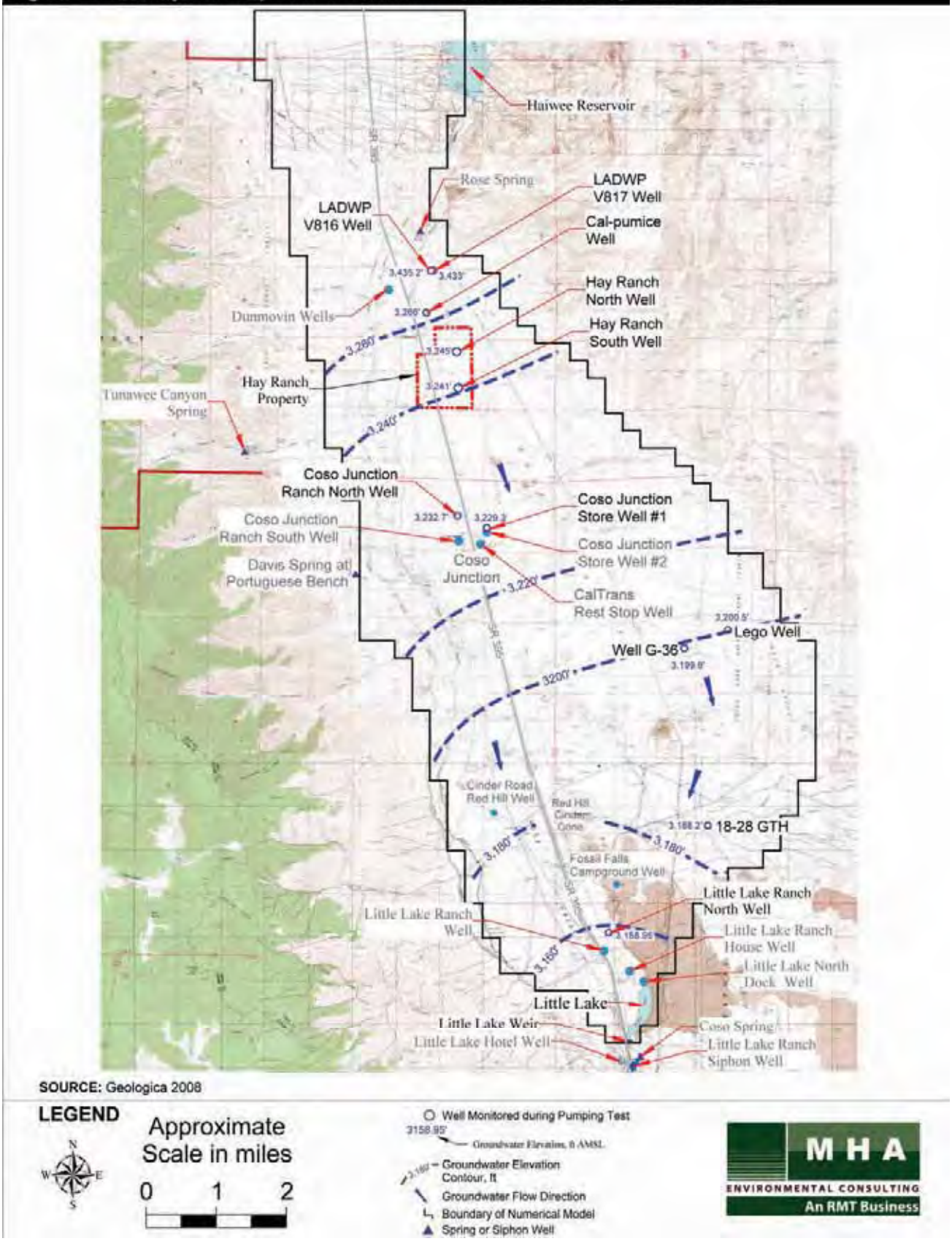
NOTE: Elevation survey to NGVD 1929 by Triad/Holme Associates (2007).

Long term groundwater level monitoring data collected by COC beginning in September 2001 are tabulated in Appendix C2, Table C2-2. Long term monitoring well locations are shown on Figure 3.2-5. Groundwater elevation hydrographs developed from the monitoring data presented in Appendix C2 are shown on Figure 3.2-4.

Long term groundwater level monitoring conducted by COC indicates that groundwater levels have generally risen 1 to 2 feet throughout Rose Valley over the last 5 years (see Figure 3.2-4). This is most likely a response to increased precipitation recharge in the mountains in the last few years. There was no significant change in groundwater extraction in Rose Valley or identified groundwater recharge other than precipitation infiltration at higher elevations. An approximately 1 foot rise in water level was observed in the Cal-Pumice well north of the Hay Ranch property,1.5 foot rises were observed in Lego and G-36 wells on Navy property 7 miles southeast of Hay Ranch, and 2 foot rises were observed in the Hay Ranch wells.

Groundwater elevations in wells at the northern end of Rose Valley may be influenced by groundwater conditions outside Rose Valley (i.e., by variations in groundwater inflow from Owens Valley or variations in seepage rates from the Haiwee Reservoirs). Groundwater levels in the LADWP wells (V816 and V817) fell from 2002 to mid-2005, rose from mid-2005 until the spring of 2007, and subsequently began falling again. Groundwater levels in the LADWP wells were more variable than in any other wells in the valley. The groundwater levels in the LADWP wells are approximately 170 feet higher than groundwater levels in the closest monitored well, Cal-Pumice, suggesting a surface water flow component or input from a groundwater basin at a different groundwater elevation potential (i.e., Owens Valley). A comparison of water level data tabulated for the Haiwee South Reservoir (LADWP 2008), 2 miles north of the LADWP wells, to groundwater levels in the LADWP wells indicated no apparent correlation between water levels in the reservoir and groundwater levels between November and December 2007. No groundwater level monitoring data were identified for wells located at the southern end of Owens Valley near the Haiwee Reservoir to evaluate inflow from this source.

Figure 3.2-5: Study Area Map and Groundwater Elevation Contour Map - November 2007



Aquifer Properties

The transmissivity (ability to transmit water through the entire thickness of aquifer) of the upper portion of the alluvial deposits in Rose Valley was previously estimated to range from 9,000 to 69,800 gallons per day/foot (gpd/ft) or 1,200 to 9,330 ft^2/day, based on data presented in the hydrology technical report prepared as part of the BLM Coso Geothermal Leasing EIS (Rockwell International 1980). Based on 24-hour pumping tests conducted in the Hay Ranch wells, GeoTrans (2003) concluded that the transmissivity of the Rose Valley aquifer near Hay Ranch was approximately 10,000 ft^2/day and estimated that the hydraulic conductivity (transmissivity divided by the aquifer thickness) was approximately 20 ft/day. GeoTrans concluded that they had insufficient data to estimate aquifer storage properties.

Based on the long-term pumping test conducted in the Hay Ranch south well and monitoring results, the best estimate of the transmissivity and horizontal hydraulic conductivity of the aquifer are approximately 14,750 ft^2/day and 24 ft/day, respectively (see Appendix C1). Vertical hydraulic conductivity was estimated to be 0.01 ft/day and the aquifer storage coefficient was estimated to be 0.001 in the recent alluvial deposits.

Groundwater Flow Components and Water Budget

The data available indicate that the Rose Valley groundwater system is mainly recharged by mountain front recharge derived from precipitation and snowmelt that falls at higher elevations in the Sierra Nevada Front Range. Some precipitation recharge likely occurs from the Coso Range on the eastern side of the valley but was conservatively neglected for the modeling effort described in Appendix C2. Based on proportions of chloride in groundwater in southeastern Rose Valley compared to groundwater in the Coso basin to the east, as much as 250 acre-ft/yr of groundwater may enter southeastern Rose Valley as groundwater inflow from the Coso Basin. This flow was conservatively neglected in modeling analysis. Leakage from the LADPW aqueducts that traverse Rose Valley was assumed to be a negligible component of total groundwater inflow to the basin.

The principal groundwater outflow components currently consist of groundwater underflow and discharges to surface water in the Indian Wells Valley to the south and evapotranspiration from Little Lake and wetland vegetation on the Little Lake Ranch property. Essentially all of the precipitation falling on Rose Valley is assumed to be lost to evapotranspiration based on data from nearby Owens Valley (Danskin 1998); however, because the groundwater table is located 40 or more feet below ground surface over all but the southern tip of the valley, evapotranspiration does not factor into the groundwater budget except on the Little Lake Ranch property. Inflow and outflow components of the groundwater budget for Rose Valley are discussed in more detail below.

Rose Valley Groundwater Inflow Components. Principal inflow components to Rose Valley consist of Sierran mountain front recharge, groundwater inflow from Owens Valley to the north, and/or outseepage from Haiwee Reservoir.

Mountain Front Recharge. Precipitation in the Sierra Nevada range west of Rose Valley is the principal source of groundwater recharge to the Rose Valley basin. Due to the rain shadow effect caused by the Sierra Nevada Range, the precipitation rate in the Coso Range on the east side of Rose Valley is low. It was conservatively assumed that evapotranspiration exceeded potential precipitation recharge throughout Rose Valley and the Coso Range, yielding no recharge in Rose Valley. Methodologies to directly measure mountain front recharge are poorly defined; typically groundwater recharge from precipitation is estimated as a percentage of total recharge.

Brown and Caldwell (2006) concluded that precipitation rates in the Rose Valley area range from about 6 inches per year (in/yr) on the valley floor to up to 20 in/yr at the crest of the Sierra Nevada range, and that only precipitation falling at elevations above 4,500 ft results in groundwater recharge. Brown and Caldwell (2006) estimated that the total precipitation volume that could potentially

recharge the Rose Valley groundwater basin was approximately 42,000 acre-ft/yr. For the purposes of the initial evaluation of potential impacts of groundwater development at Hay Ranch, they further assumed that only 10% (4,200 acre-feet/year) of the potential mountain front precipitation recharge actually reaches Rose Valley. The mountain front precipitation recharge rate as assumed for the Brown and Caldwell groundwater flow model yielded reasonable calibration results in the steady state model; therefore, a recharge rate of 4,200 acre-ft/yr was also used in the revised numerical model developed for this EIR. The recharge was assigned to selected nodes on the western boundary of the model, primarily along the trace of ephemeral streams (see Appendix C2).

Groundwater Inflow/Seepage from the North. Weiss (1979) estimated seepage losses from the Haiwee Reservoir to be on the order of 600 acre-ft/yr. Previous investigations (Bauer 2002; Brown and Caldwell 2006) and the review of groundwater elevation contour patterns in the north end of Rose Valley indicate that groundwater inflow from southern Owens Valley and/or seepage losses from the south Haiwee Reservoir recharge the Rose Valley groundwater basin at the north end of the valley. Using a steady-state numerical groundwater flow model of the Rose Valley groundwater basin, Brown and Caldwell (2006) estimated the groundwater influx from the north to be approximately 788 acre-ft/yr, which is similar to the estimate in Weiss (1979). Recalibration of the numerical groundwater flow model for this study indicated a slightly higher groundwater inflow rate from the north (Owens Valley/Haiwee Reservoir) of 898 acre-ft/yr.

Groundwater Outflow Components. Principal groundwater outflow components from Rose Valley consist of discharge to Indian Wells Valley in the Little Lake area and an area in the southeastern part of the valley, east of Red Hill, and evapotranspiration in the Little Lake area. Limited groundwater extraction was identified in Rose Valley.

Groundwater Discharge from Southeastern Rose Valley. Brown and Caldwell (2006) estimated that approximately 2,050 acre-ft/yr of groundwater discharges from Rose Valley in the southeastern part of the valley (southeast of Navy well 18-28) as underflow to Indian Wells Valley. Williams (2004) concluded that existing estimates of recharge to the Indian Wells Valley significantly underestimated interbasin transfers and referenced an estimate of groundwater underflow from Rose Valley to Indian Wells Valley of 10,000 acre-ft/yr developed by Thompson (1929). Recalibration of the numerical groundwater flow model for Rose Valley indicated an underflow rate from Rose Valley to Indian Wells Valley in this area of 850 acre-ft/yr. This rate is less than half the value of 2,050 acre-ft/yr assigned to this term in the earlier Brown and Caldwell (2006) numerical modeling analysis. This difference is discussed in the model calibration section of Appendix C2.

Groundwater Discharge at Little Lake. Water is removed from the Rose Valley aquifer by several processes. These include:

- Evaporation from the surface of Little Lake and surrounding ponds
- Transpiration from plants on the Little Lake property
- Groundwater discharge to Indian Wells Valley

Bauer (2002) estimated that evaporation from the Little Lake water surface consumes approximately 500 acre-ft/yr based on a lake surface area of 75 acres and a potential evaporation rate of 80 inches/yr. As discussed in Section 3.4, plant communities and habitat identified on the Little Lake Ranch property were described as alkali desert (saltbush scrub), palustrine (pond) and lacustrine (lake) wetlands, and riparian (creek) habitat. Beginning in 2000, Little Lake Ranch, Inc., conducted various projects intended to create 90 acres of open waters, 10 acres of palustrine emergent wetlands, about 6 acres of palustrine/riparian habitat (1.6 mile long creek corridor), an additional 220 acres of wetland and upland habitat, and 1 acre of wetland and associated upland habitat (ULLR 2000).

As a result of shallow groundwater in this area and the information presented above, it is estimated that about 300 acres of the 1,200 acre Little Lake Ranch property hosts various species of plants. Studies summarized in the USGS Water-Supply Paper for Owens Valley (Danskin 1998) concluded that wetland plant species in the desert climate prevalent in Owens (and Rose Valley) transpire between 20 and 36 inches/yr. Using an average evapotranspiration value of 28 inches/yr over the 300 acres yields an estimated 700 acre-ft/yr for transpiration processes (in addition to 500 acre-ft/yr assumed for surface water evaporation from Little Lake). The estimation of evapotranspiration is likely an overestimate because not all 300 acres includes plants with wetland evapotranspiration rates.

The combined total of measured lake, spring, and groundwater discharges and estimated evapotranspiration losses in the Little Lake Ranch area was approximately 4,200 acre-ft/yr. All of the groundwater discharged through the entire saturated thickness of aquifer in the Little Lake area that is not evaporated or transpired by plants infiltrates back into the ground on the property (approximately 3,000 acre-ft/yr) and continues as groundwater underflow to Indian Wells Valley. This is slightly lower than the value of 3,300 acre-ft/yr estimated by Williams (2004) for interbasin transfer from Rose Valley to Indian Wells Valley, but does not include the groundwater underflow component from the southeastern Rose Valley discussed in the previous section.

Existing Extraction Wells. Groundwater production from wells in Rose Valley is currently approximated at 50 acre-ft/yr. No significant agricultural irrigation has occurred in the valley since the Hay Ranch alfalfa growing operation ceased. As many as 30 domestic wells are believed to extract relatively small quantities of groundwater for domestic uses and small scale irrigation in the Dunmovin area. This pumpage is not represented in the groundwater flow model because it is believed to amount to less than 10 acre-ft/yr. The LADWP, Cal-Pumice, and Hay Ranch wells are not being pumped and are not known to have been used in the last five years. The Coso Ranch south well, southern Coso Junction store well (Coso Junction #2), and the CalTrans well at Coso Junction are regularly used for businesses in the area. The Coso Ranch north well and northern Coso Junction store well (Coso Junction #1) are not being used at present. Cal-Pumice reportedly takes 5 to 10 truckloads (15,000-30,000 gallons) of water a day during the week from the Coso Ranch south well, which was set in the model as a continuous withdrawal of 17 acre-ft/yr (or roughly 10 gpm). The Coso Junction Store well supplies the general store and COC offices in Coso Junction and was also represented as a continuous withdrawal of 17 acre-ft/yr. Extraction from the CalTrans well was assumed to be negligible. At the southern end of Rose Valley, the Red Hill well on Cinder Road is believed to be used for supplying water for the cinder pit at Red Hill. The volume of water needed for this operation is estimated to be 2 to 4 truckloads (approximately 5,000 to 10,000 gallons) per day, based on anecdotal information. Wells on the Navy property in Rose Valley including the Lego well, well G-36, and well 18-28, are not being pumped. Water wells on the Little Lake Ranch property were discussed in the previous section.

Groundwater Budget

The groundwater elevation monitoring data shows a general rise in water levels that suggests that groundwater inflows (sources) have equaled or slightly exceeded groundwater outflows from the Rose Valley groundwater basin in the past five years. Assuming that groundwater inflows equal outflows (i.e., steady state conditions prevail) is a conservative approach that underestimates the amount of available groundwater. The resulting Rose Valley groundwater budget was evaluated under this conservative assumption, using a numerical model (refer to Appendix C2) as shown in Table 3.2-3.

Table 3.2-3: Rose Valley Conceptual Groundwater Budget

Budget Components	2006 Model		2007 Model	
	Flow Rate, acre-ft/yr	Simulation Package used in Model	Flow Rate, acre-ft/yr	Simulation Package used in Model
Groundwater Inflow				
Mountain Front Recharge from west	4,191	Well	4,194	Well
Groundwater Underflow from the North	788	Constant Head	898	Constant Head
Total Inflow	**4,979**		**5,092**	
Groundwater Outflow				
Existing extraction wells	0	--	50	Well
Groundwater underflow to Indian Wells Valley exiting from southeastern Rose Valley	2,050	General Head	842	General Head
Evaporation from Little Lake and Evapotranspiration from adjacent Palustrine wetland plants	500	Evapotranspiration	700	Evapotranspiration
Phreatophyte plant transpiration on Little Lake Ranch property south of Little Lake (outside model grid)	0	--	500	--
Groundwater Discharge through Little Lake Gap to Indian Wells Valley	2,429	Drain	3,000	General Head
Total Outflow	**4,979**		**5,092**	

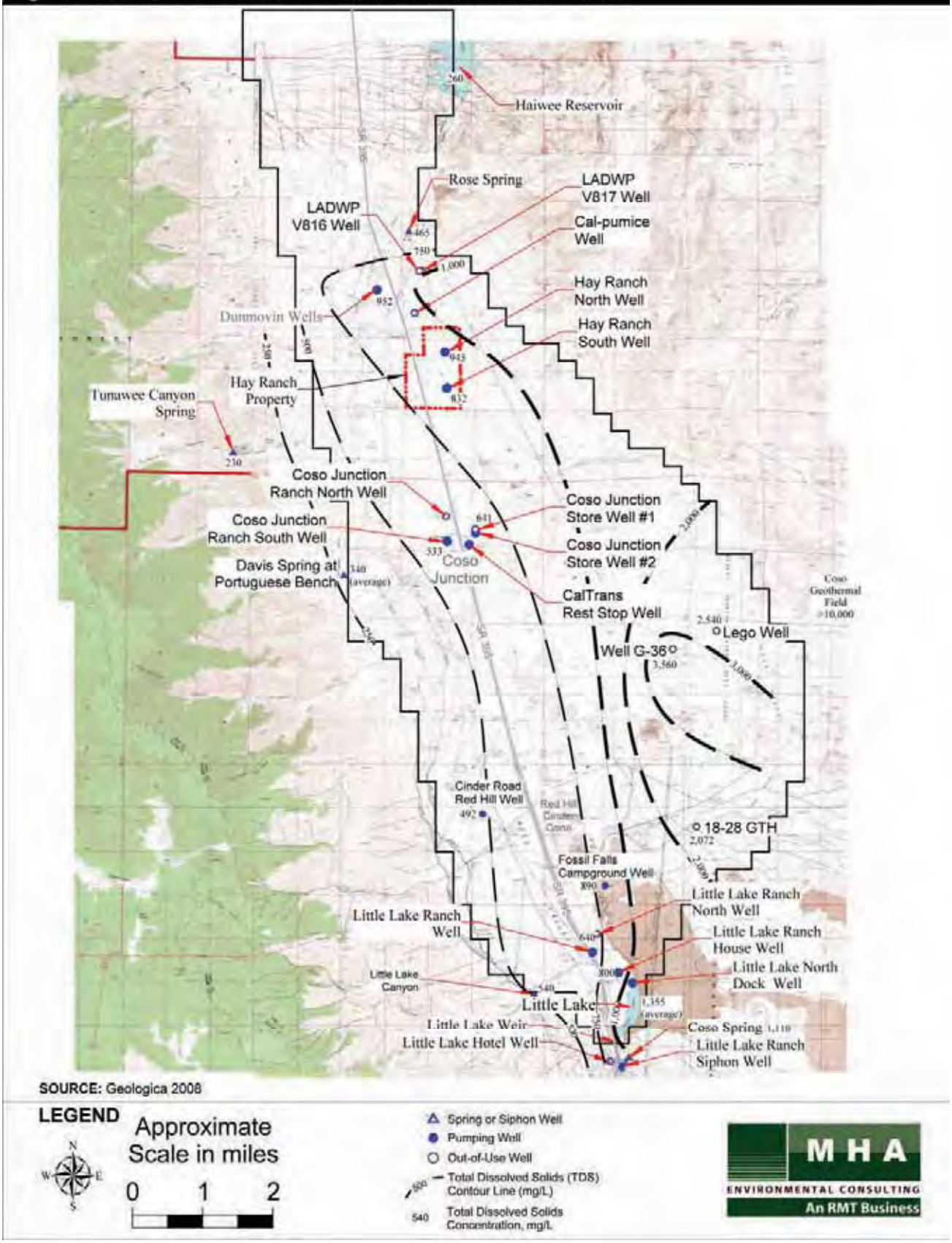
*Conceptual budget, simulated budget components were adjusted during model calibration process.

Water Quality

The chemistry of waters found in Rose Valley watershed varies widely reflecting the multiple types of waters within the hydrological system of semi-arid western US environments. The water chemistries are influenced by the interaction between groundwater and rock along the hydrological flow paths with the addition of a geothermal brine component. Recharge waters from drainage of the mountains surrounding Rose Valley have lower dissolved solids than the valley's groundwater, which typically is higher in dissolved solids reflecting longer transit times and a greater degree of water-rock interaction. Surface waters can be even higher in dissolved solids where it is impacted by evaporation (Guler 2002). Outflow of saline geothermal brines from the Coso geothermal system to the east may also provide a component of flow to the Rose Valley hydrological system.

Total dissolved solids (TDS) range from very low to a few hundred milligrams per liter (mg/L) in surface streams draining the Sierras to the west or in springs of the Coso-Argus Range to the east to several thousand mg/L in geothermal brines in the Coso Geothermal Wellfield to the east. Groundwater in the northern Rose Valley near Hay Ranch is characterized by TDS between 800 and 900 mg/L whereas groundwater in the southern Rose Valley is characterized by TDS from 500 to 700 mg/L. At Little Lake the water is slightly brackish with TDS from 1,500-2,500 mg/L. The TDS levels throughout the Rose Valley are shown in Figure 3.2-6.

Figure 3.2-6: Inferred Total Dissolved Solids Concentration Distribution



Chemical analysis of water samples collected in the Rose Valley and vicinity indicates that there are several distinct water types (refer to Appendix C4). Sierran waters (and minor amounts of water from the Coso Range) recharge the area (Guler 2002 and Williams 2004). There also appears to be a small inflow of subterranean discharge from the Coso Geothermal System. The chemistry and isotopic signatures of the other types of water suggest that the Rose Valley hydrological system contains waters that have followed different and sometimes complex pathways from their mountain sources to points of discharge.

Guler (2002) and Williams (2004) compiled an extensive database of chemical analyses of waters within the area to evaluate and characterize water quality. They grouped the waters within the area into several water types:

- Sierran: springs and streams that drain the Sierras; calcium (Ca)- (sodium, Na)-bicarbonate (HCO_3); average TDS≈200 mg/L
- Indian Wells Rose Valley: springs, streams and shallow groundwater in basins along the eastern side of the Sierra; Na-Ca-HCO_3-(sulfate, SO_4); average TDS≈700 mg/L
- Coso-Argus Group: surface and spring samples from the Coso and Argus Ranges; Ca-HCO_3 - average TDS≈500 mg/L
- Little Lake Group: Samples from Little Lake and surrounding springs; Na-(Mg)-HCO_3 -Cl; average TDS≈1200 mg/L
- Geothermal Brine: from deep (500-3000m Coso geothermal reservoir); Na-Cl; TDS≈10,000 mg/L

A review of chemical and isotopic analysis of water samples from Rose Valley suggests that Sierran, Indian Wells-Rose Valley (IWRV), Little Lake (LL), and possibly a component of geothermal brine types are present in Rose Valley groundwater. Within the IWRV type, Portuguese Bench, Coso Junction, and Hay Ranch waters are clearly distinguished from each other and from Little Lake and geothermal waters, particularly in the conservative element of chloride. Little Lake waters, represented by the LL Ranch House Well, LL (an average of surface waters), and the Coso Spring are clearly distinguished from other Rose Valley groundwaters by higher concentrations of all constituents except Ca and Mg. The only exception is the geothermal-influenced Lego and 18-28GTH wells. Williams (2004) suggests that elevated Na relative to Ca, Mg, and Cl, as well as boron (B) and lithium (Li), indicate a geothermal component in Little Lake waters. However, the elevated chloride in Little Lake waters may also be a result of evaporation (concentration) of waters from nearby Sierran recharge from the west (as represented by Little Lake Canyon Spring) combined with groundwater flow down the valley (represented by Little Lake north well water).

Chemical Analyses and Water Types

Hay Ranch groundwater appears to be a more concentrated version of Haiwee Reservoir water. The dominance of sulfate in waters in the northern part of Rose Valley (Hay Ranch and Dunmovin) distinguishes these waters from the rest of the valley. Although the Hay Ranch wells were drilled deeper than many of the other wells in the valley, the Dunmovin well is not, so depth alone probably does not produce the difference in water chemistry. Concentration of these waters by evaporation would not produce the chemistry of the Little Lake waters.

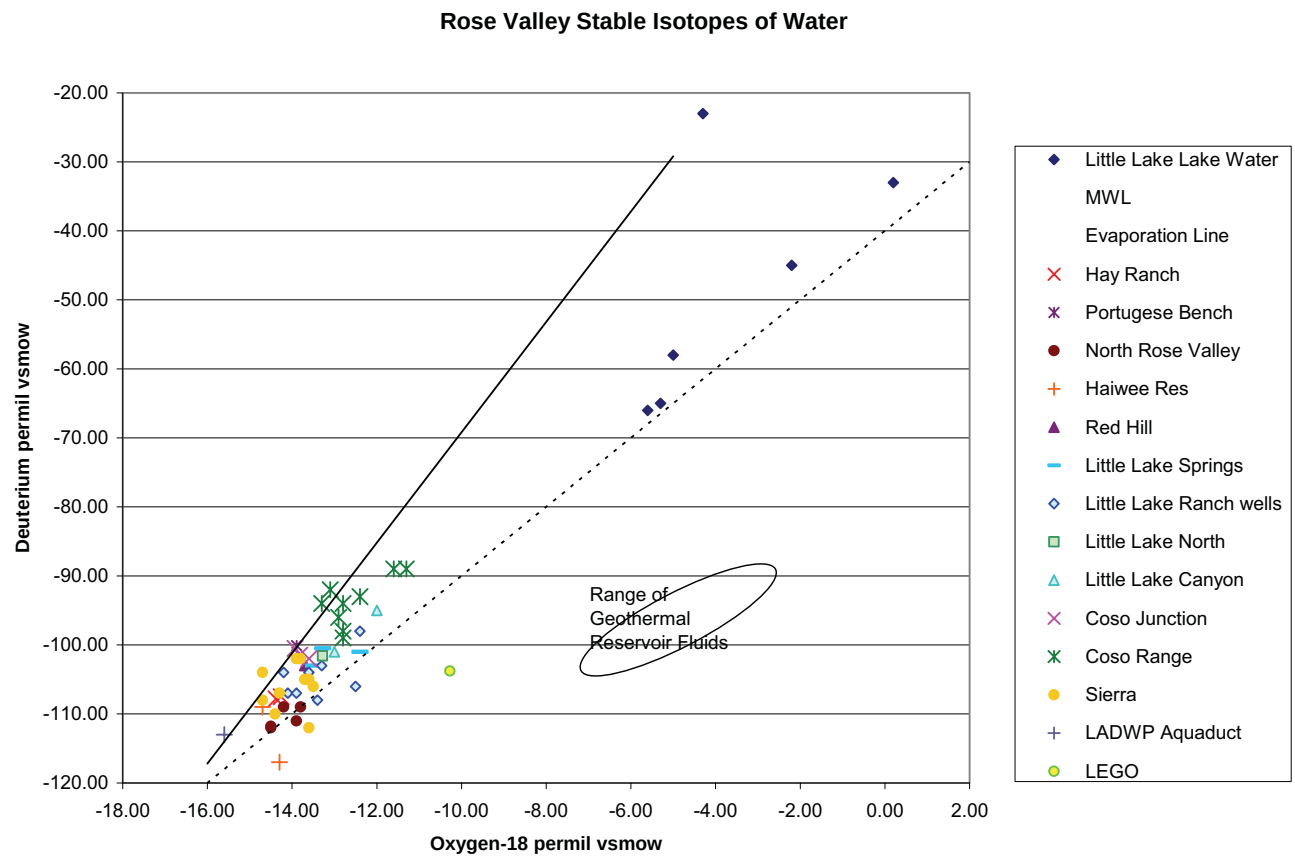
Despite the different chemistries of waters at discharge points within Rose Valley watershed most waters appear to generally have the same origin. Similar boron/chloride ratios (the ratio of two relatively conservative elements) support similar origins. Boron/chloride ratios within the Hay Ranch watershed are similar to water from the Sierras and to the Coso geothermal waters suggesting that although various processes change the absolute concentrations of these conservative elements, the source of the water is likely precipitation in the Sierra and Coso Ranges.

Isotope Data

Stable water isotope (oxygen-18 and deuterium) signatures are commonly used to evaluate the origins of waters. Isotope concentrations of waters from within the Rose Valley and its watershed reflect variable sources as well as evaporation. Evaporation enriches waters in the heavier stable isotopes making the waters less isotopically negative. At first glance, the stable isotopes of Little Lake waters appear different from all other waters reflecting the evaporation of these shallow lakes (Figure 3.2.7).

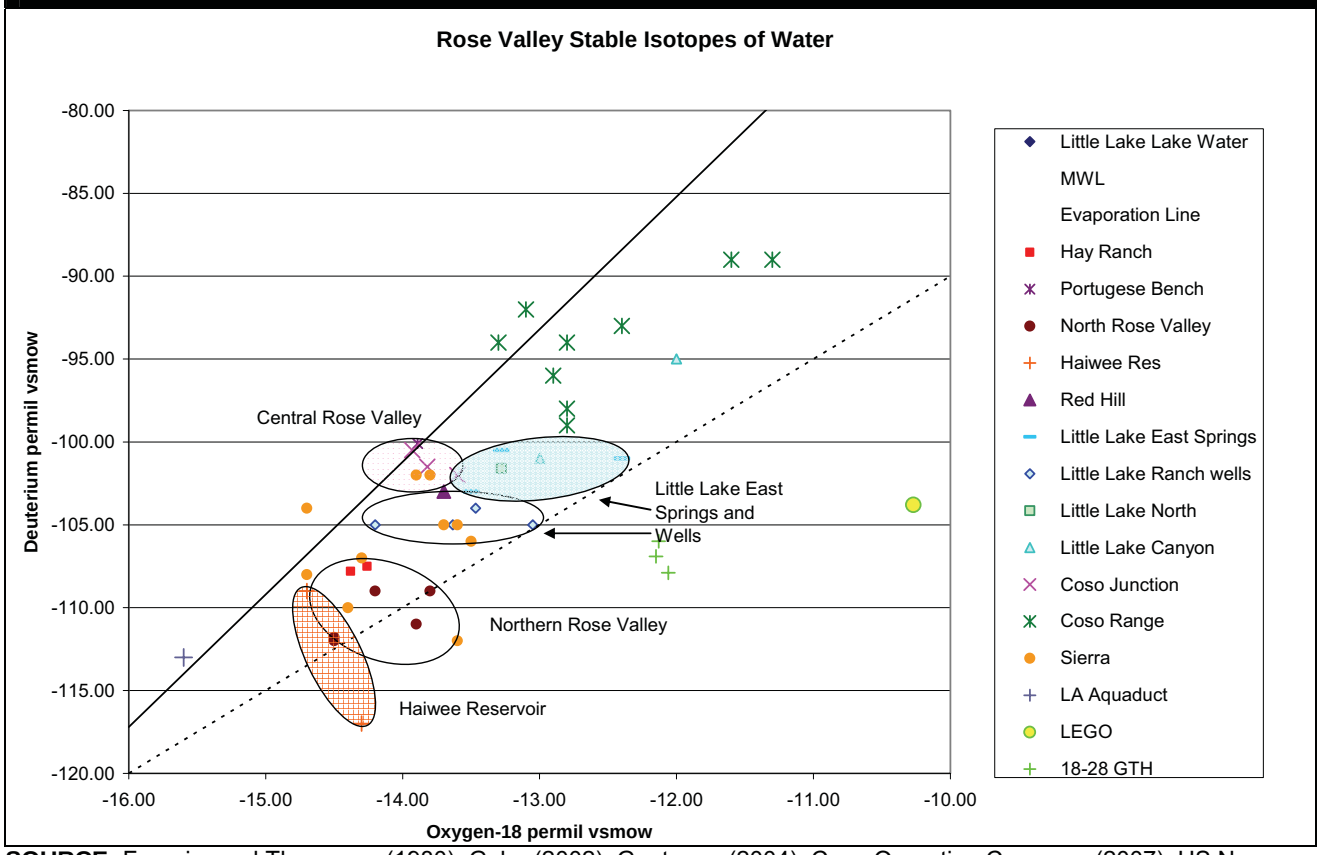
When focusing on groundwater represented by well and spring waters (minimizing the effect of evaporation), stable isotopes also suggest differences in sources of groundwaters from the northern to the southern end of the valley. These differences may in part reflect differences in recharge from the Sierra, which is isotopically lighter (more negative) to the north as represented by the LADWP Aqueduct water and Haiwee Reservoir and isotopically heavier (less negative) in the south. The stable isotopic signature of the northern part of the Valley (including Hay Ranch waters) is similar to the Haiwee Reservoir and the highest or more northerly Sierras. Portuguese Bench and Coso Junction waters appear to be similar to each other and isotopically more like the Sierras farther south than Haiwee and more directly west of Rose Valley (Figure 3.2-8). Thus, the isotopic signature of Rose Valley groundwaters suggest that there is recharge from the Sierras all along the north-south axis of the valley, with different isotopic signatures, in addition to some valley underflow from north to south.

Figure 3.2-7: Stable Isotopes of Waters from Rose Valley and Vicinity



SOURCE: Fournier and Thompson (1980), Guler (2002), Geotrans, (2004), Coso Operating Company (2007).

Figure 3.2-8: Oxygen-18 versus Deuterium for Waters from Rose Valley and the Surrounding Areas



SOURCE: Fournier and Thompson (1980), Guler (2002), Geotrans, (2004), Coso Operating Company (2007), US Navy GPO (2007 and 2008).

The isotopic signature of groundwater in wells or springs downgradient from Little Lake (i.e., Little Lake East Spring, also known as Coso Spring, and Little Lake Ranch Wells) is probably affected by evaporation of the lake water. Little Lake North Well probably represents unevaporated recharge to the Lake. The source waters for Little Lake appear to be either:

1) From the Sierran source area of Portuguese Bench springs with a longer subsurface pathway (which increases oxygen-18 by water-rock interaction but not deuterium), or
2) Predominantly Portugese Bench type Sierra water and a small amount of geothermal water (or geothermal mixed water), or
3) Predominantly Portuguese Bench type Sierra water and a small amount of Rose Valley underflow from the north.

If the major source of Little Lake water was directly from the Hay Ranch area, significant evaporation would have to occur at Little Lake to change the water chemistry. Groundwater flow within the Rose Valley would have a major diversion around Coso Junction, or alternatively, Little Lake water is influenced from the geothermal waters to the east. In either case, water isotopes suggest the water sources for the Little Lake area are predominantly from the local Sierran watershed to the west and are distinct from the Northern Rose Valley water chemistries, potentially indicating more recharge from the west than from the north. Slight displacement towards a lighter isotopic signature from the area around Portuguese Bench may reflect a slight influence of groundwater underflow from north to south through Rose Valley.

Water Potability

Drinking water quality (potability) of waters within the Rose Valley ranges from excellent to marginal. Available data (Coso 2007; Geotrans 2004) indicate that Hay Ranch waters exceed primary drinking water standards (EPA 2003) for arsenic, nitrate and nitrite Secondary drinking water standards are primarily related to aesthetics and taste. Several waters exceed the secondary drinking water standard levels for TDS and sulfate (Coso 2007; Williams, 2004; Fournier and Thompson 1980). Recent analysis of water samples from the Hay Ranch wells indicates the water does not meet secondary drinking water standards for TDS, sulfate, iron and manganese (see Table 3.2.4 from Geotrans 2004).

Geothermal System and Surface Manifestations

The local hydrological setting of the Hay Ranch area includes a high temperature (200-328°C) hydrothermal system and associated surface manifestations located within the Coso Range between Rose Valley and Coso Wash.

The Coso hydrothermal system supports the Coso geothermal field, which has been producing geothermal fluids for electrical power generation since late 1987. There are several surface manifestations of the system known as Coso Hot Springs. Approximately 14,000,000 lbs/hour of hot geothermal steam and brine are produced from approximately 80 to 90 deep (3,300 to 10,000 feet bgs,) wells (Adams et al. 2000; Monastero 2002) for power generation. This fluid is flashed to steam and the steam powers the turbine while the unflashed portion of the brine is injected into the subsurface. The injection rate is approximately 50% of the production rate constituting in a net loss of fluid in the reservoir which, over 20 years of production, has resulted in a decline in pressure and development of a vapor-dominated zone (ITSI 2006; Adams 2004). Initially, fluid was produced from a predominantly liquid-dominated reservoir at an average total enthalpy of just above 400 Btu/lb. Now the average enthalpy is closer to 800 Btu/lb, suggesting that a significant portion of the produced fluid is from a vapor-dominated zone of the reservoir.

The project includes transferring water to the Coso geothermal field for injection. The Coso geothermal field project has been permitted through 2031.The geothermal system is part of the hydrogeologic setting of the project and, therefore, a brief description follows.

Geothermal System

The Coso hydrothermal system has been in existence for over 300,000 years. Temperature and fluid chemical variations over its existence (pre-production) may reflect variations in heat supply and recharge (Adams et al. 2000). Coso is located in a tectonically active area southwest of the Walker Lane, east of the Sierra Nevada, and north of the Garlock fault zone (Montasero 2000, Unruh et al., 2002). The system appears to be heated by shallow (approximately 4 km; Wicks et al. 2001; 4-5 km, Lees 2002) magma associated with the brittle ductile transition zone. Volcanic rocks related to this magma date from 4 million to 40,000 years (Duffield et al. 1980).

The source of the geothermal fluids appear to be meteoric waters from the Sierra Nevada (Fournier and Thompson 1980) or the Coso Range (Williams and McKibben 1990) or both (Williams 2004), with contributions of volatiles and other fluids from magmatic sources. However, there does not appear to be any current natural recharge to the system. Climate has changed from the last glacial periods to the currently dry and arid conditions. Over this same period and before development, the low-salinity non-thermal groundwater system that overlaid and recharged earlier phases of the geothermal system disappeared (Adams et al. 2000).

Before development, the geothermal system appears to have been a sodium chloride liquid-dominated system. The Coso geothermal field appears to have been developed in phases. Development involves production of hot brine from deep (4,000-9,000 feet) wells, boiling and

Table 3.2-4: Hay Ranch Drinking Water Quality with Primary and Secondary Drinking Water Standards

HAY RANCH NORTH AND SOUTH WELL GROUNDWATER ANALYTICAL RESULTS for Drinking Water Quality

ANALYTE	Drinking Water Standard[1]	MCL[2] or Secondary Level[2] (mg/l)	South Well 09/10/2003 Result[3] (mg/l)	South Well 09/11/2003 Result[3] (mg/l)	South Well 12/03/2007 Result (mg/l)[4]	North Well 09/13/2003 Result[3] (mg/l)	North Well 09/14/2003 Result[3] (mg/l)	Coso Junction Office Well[4] 01/30/03 Result[3] (mg/l)
General Minerals								
Alkalinity, Total			330	320		260	250	
Bicarbonate (as $CaCO_3$)			330	320		260	250	326
Carbonate (as $CaCO_3$)			ND	ND		ND	ND	
Hydroxide (as $CaCO_3$)			ND	ND		ND	ND	
Chloride	Secondary	250	74.1	75.7	73	72	79	33.7
Conductivity (umho/cm)			1320	1300		1360	1370	
Cyanide	Primary (CA)	0.15			<0.1			
Fluoride	Primary	2.0	0.22	0.20	0.31	0.15	0.20	0.53
Hardness (Ca, Mg-$CaCO_3$)			465	455		430	430	
Nitrate	Primary	10	2.15	2.60	**12**	1.44	2.05	6.01
Nitrite	Primary	1			**2.7**			
Sulfate	Secondary	250	**257**	**251**	**260**	**336**	**329**	97.3
Total Dissolved Solids (TDS)	Secondary	500	**850**	**844**	**850**	**910**	**945**	**634**
Other								
pH (pH units)	Secondary	6.5-8.5	7.12	7.28	7.61	7.43	7.48	6.53
Color	Secondary	15 units			<3.0			
ODOR	Secondary	3 TON			<1.0			
MBAS	Secondary	0.5			<0.05			
Asbstos	Primary	7 MFL			<0.2 MFL			
Metals								
Aluminium	Primary (CA)	1			0.054			
Antimony	Primary	0.006	ND	ND	<0.002	ND	ND	
Arsenic	Primary	0.010	ND	ND	**0.016**	ND	ND	0.0034
Barium	Primary	2	0.058	0.042	<0.1	0.036	0.033	
Beryllium	Primary	0.004	ND	ND	<0.001	ND	ND	
Cadmium	Primary	0.005	ND	ND	<0.001	ND	ND	
Calcium			114	113		97.6	96.3	73.7
Chromium	Primary	0.1	ND	ND	<0.01	0.012	ND	
Cobalt			ND	ND		ND	ND	
Copper	Primary	1.3	ND	ND	<0.05	ND	ND	
Flouride	Primary	0.002						
Iron	Secondary	0.3	**7.01**	0.27	<0.1	**1.35**	0.114	
Lead	Primary	0.005	ND	ND	<0.002	ND	ND	
Magnesium			39.8	37.7		37.6	36.0	36.6
Manganese	Secondary	0.05	**0.449**	0.047	<0.02	**0.100**	0.012	
Mercury	Primary	0.002	ND	ND	<0.0002	ND	ND	
Molybdenum			ND	ND		ND	ND	
Nickel			ND	ND		ND	ND	
Potassium			11.8	11.8		8.67	9.38	6.91
Selenium	Primary	0.05	ND	ND	0.003	ND	ND	
Silver	Secondary	0.10	ND	ND	<0.01	ND	ND	
Sodium			111	111		136	133	50.3
Thallium	Primary	0.0005	ND	ND	<0.001	ND	ND	
Vanadium			ND	ND		ND	ND	
Zinc	Secondary	5	0.032	0.022	<0.05	0.033	0.036	

1 - Primary and Seconday Drinking Water Standards as defined by the US EPA, June, 2003 inless noted with CA for California Standards.
2 - MCL = Maximum Contaminant Levels are legally enforceable standards that apply to public water systems;
Secondary Levels are suggested but not enforceable guidelines for drinking water.
3 - Results are bold for those that exceed the MCL or Secondary Level for the respective analyte.
4 - Coso Junction office well results received from Paul Spielman, Caithness Energy.
This table is compiled from Geotrans, 2004 with addition from Coso in 2007.
South Well sampled September 10-11, 2003 and December 3, 2007; North Well sampled September 13-14, 2003.

SOURCE: GeoTrans 2004, COC 2007, EPA 2003 (standards)

separation of resulting steam and waste brine, and reinjection of spent brine and steam condensate. The reservoir now appears to be compartmentalized into at least three weakly connected areas with the hottest and deepest in the south. Subsequent production-induced pressure declines have produced vapor-dominated portions of the field today, causing some production wells to produce only steam.

Surface Manifestations

The geothermal surface manifestations at Coso are primarily located along the Coso Wash Fault northeast of the Coso geothermal field. Coso Hot Springs lie just east of the fault and Devils Kitchen lies further west. These surface manifestations appear to be primarily related to steam discharge from the geothermal system along fractures, but some features discharge fluids with some portion of geothermal brine. All features are characterized by variable discharge rates or water levels and temperatures (Geologica 2007).

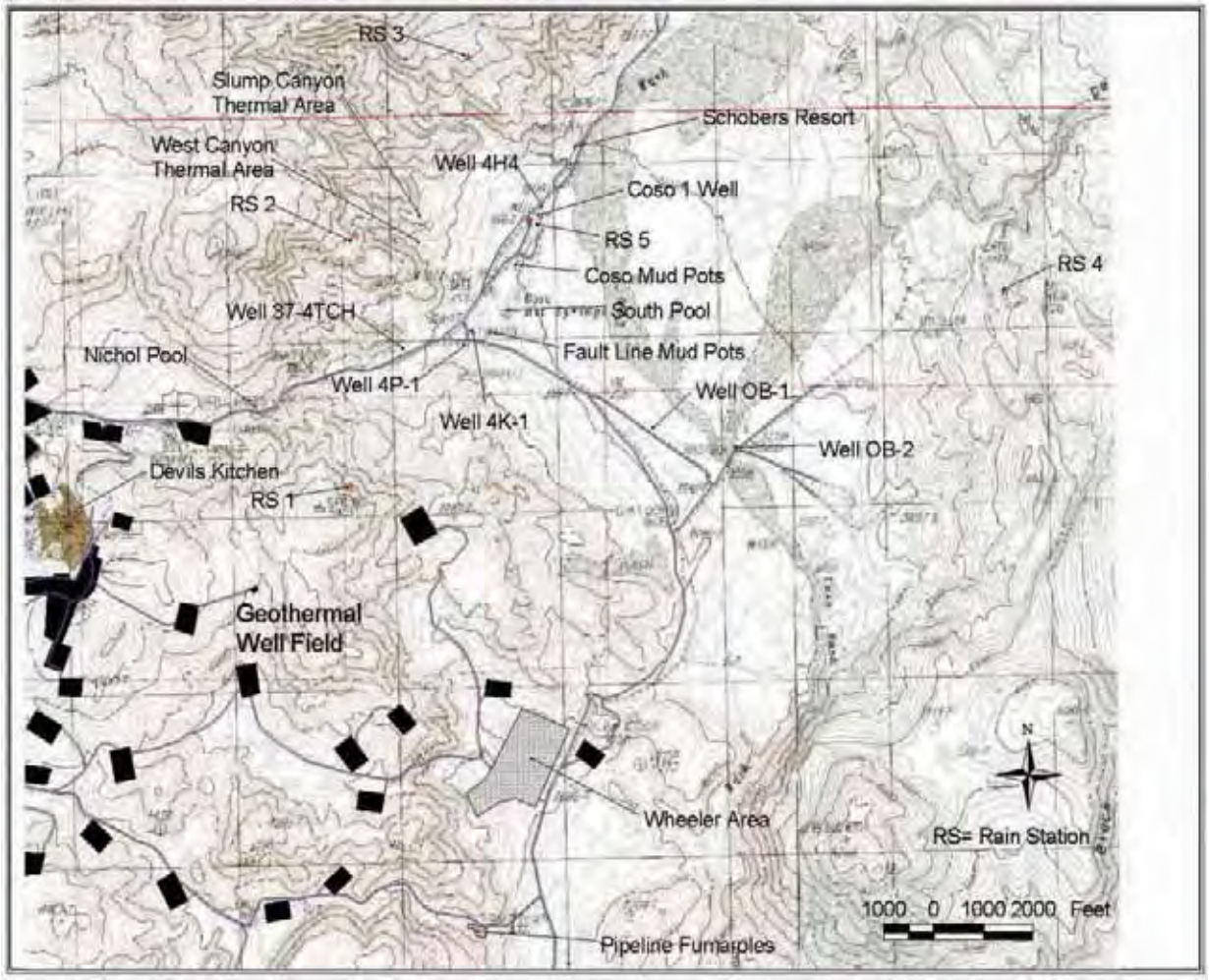
The Navy monitors surface manifestations to comply with a 1979 Memorandum of Agreement (MOA) between the CLNAWS, the State Historic Preservation Office (SHPO), and the Advisory Council on Historic Preservation (ACHP) and to document the physical and chemical conditions of the Coso Hot Spring Archeological District in order to “avoid or satisfactorily mitigate any adverse effects on significant historic or cultural property.” Baseline studies and continuous annual monitoring have been part of the Navy’s technical program since the Coso geothermal field was considered for leasing and development. Monitoring has established an accurate and reliable record of the physical conditions of surface manifestations. The Coso Hot Springs monitoring program includes the collection of:

- Local meteorological data
- Measurements of fumaroles and mud pots
- Photographic documentation
- Water level measurements in selected water wells
- Chemical data from select fluid samples
- Steam flow measurements from selected monitoring points (see Figure 3.2-9).

South Pool (Figure 3.2-10a) and Devil’s Kitchen (Figure 3.2-10b) are prominent surface manifestations at Coso Hot Springs. The South Pool has been the principal focus of efforts to monitor surface manifestations. The other historically prominent feature is Devil’s Kitchen, which was dry for the second year since monitoring began during 2005-2006. Other consistently active areas, such as the Wheeler Area (Wheeler Mercury Prospect), the Slump Canyon thermal area, West Canyon thermal area, and Nichol Pool (Figure 3.2.10c), are variable in character and level of activity. For example, Pipeline Fumaroles (Figure 3.2.10d) became more active after the year 2000 but were dry in 2006. During the 2005-06 sampling season, increased activity was observed at the Fault Line Pool (near South Pool). Approximately 20 small fumaroles, approximately two inches high, were observed forming in November 2005.

Fluids in the Coso Hot Springs area are primarily steam, steam condensate, or steam-heated groundwater (which contains negligible amounts of chloride). Major cation (Figure 3.2-11) and anion concentrations in the surface manifestations reflect the type of fluid feeding the feature. Discharge of the sodium-chloride brine discovered in Coso Well #1 is limited to the east side of the Coso Wash Fault (Wheeler area, OB-1, and OB-2) and Nichol Pool (Figure 3.2.2e). The remainder of the features, including South Pool (Figure 3.2.10a), Devil’s Kitchen (Figure 3.2-10b) and Pipeline Fumarole (Figure 3.2-10d), are predominately low-pH sulfate calcium-magnesium fluids typical of

Figure 3.2-9: Coso Hot Springs Surface Manifestations and Monitoring Points



SOURCE: Geologica 2008

Figure 3.2-10a: South Pool

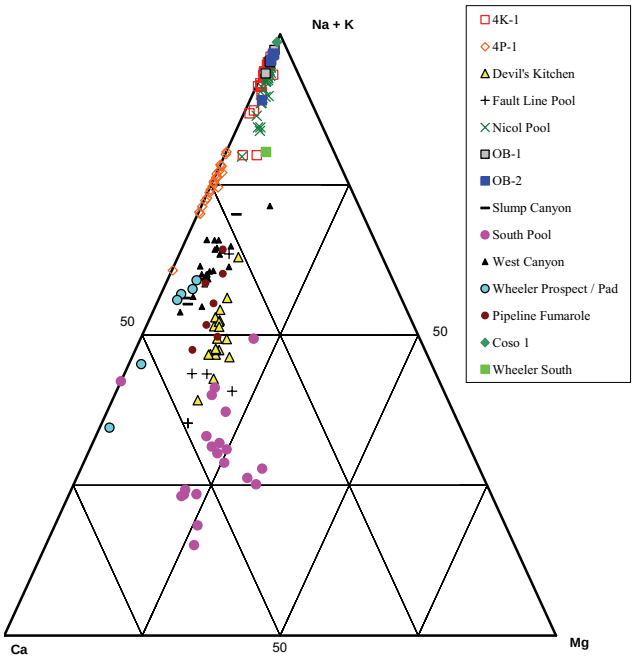
Figure 3.2-10b: Devil's Kitchen

Figure 3.2-10c: Nichol Pool

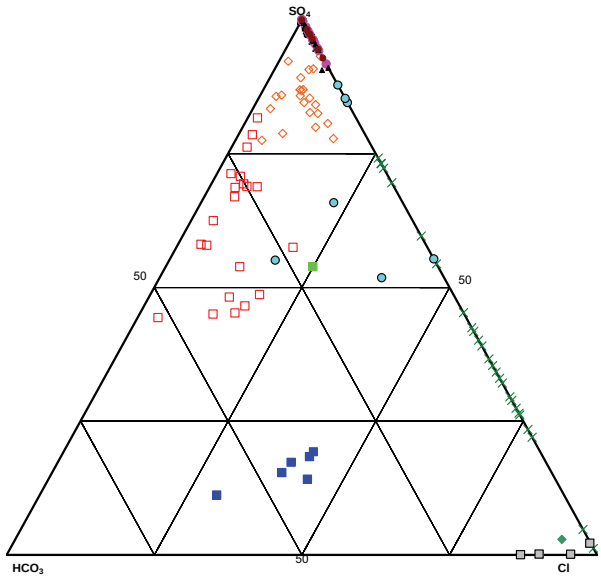
Figure 3.2-10d: Pipeline Fumarole

SOURCE: Geologica 2008

Figure: 3.2-11: Relative Proportions of Anions and Cations in Coso Surface Manifestations



Relative proportions of cations in Coso surface manifestations: sodium+potassium (Na+K), magnesium (Mg), and calcium (Ca). Brine-dominated features cluster at the top (Na+K) of the triangle, steam-fed at the bottom (Ca-Mg).

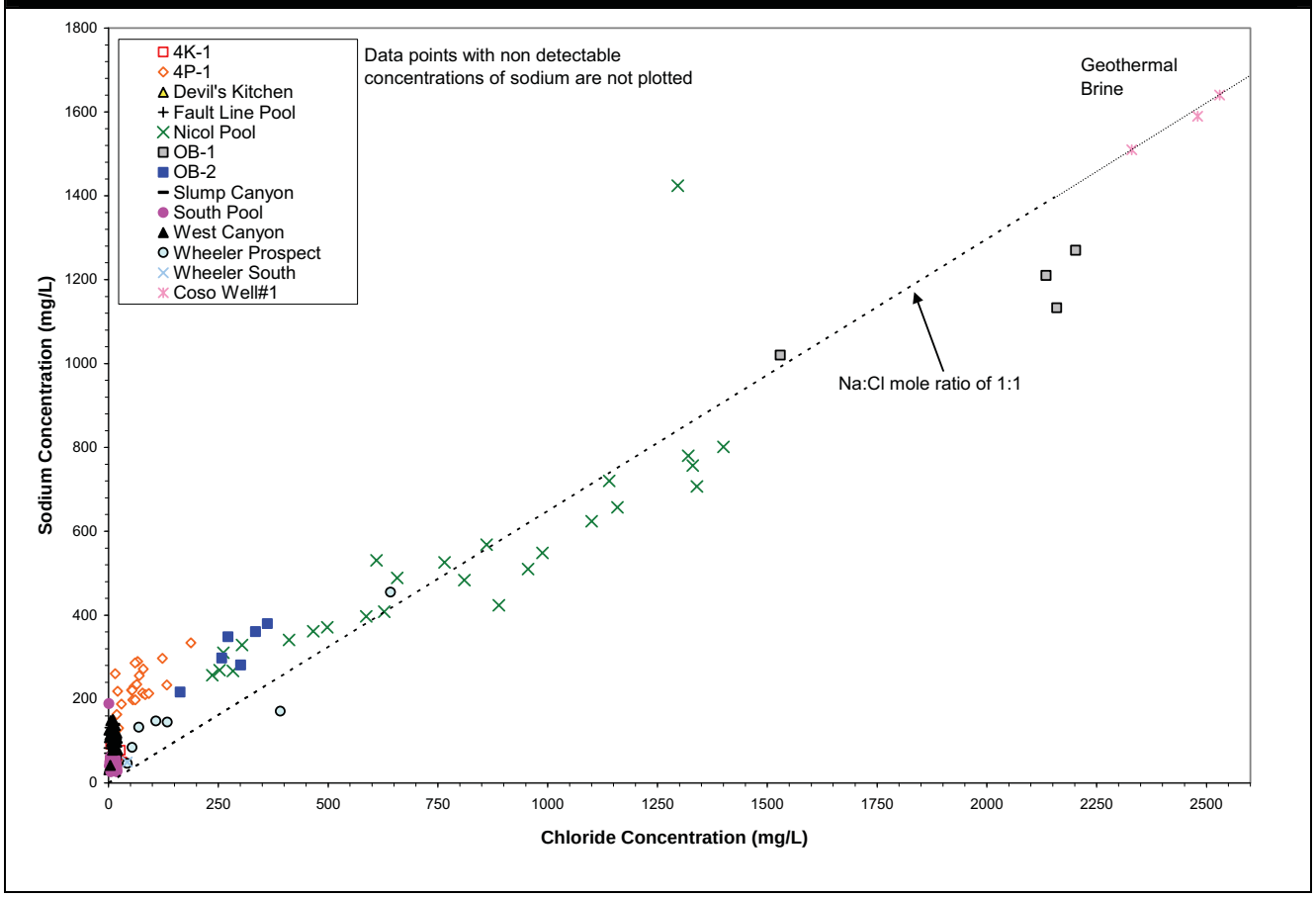


Relative proportions of anions in Coso surface manifestations: sulfate (SO4), bicarbonate (HCO3), and chloride (Cl). Steam-fed features cluster at the top (SO4) of the triangle, brine-dominated at the bottom right (Cl), and groundwater at the left (HCO3).

steam-fed geothermal features such as fumaroles and mud pots. Concentrations of sodium and chloride (Figure 3.2-12) clearly distinguish between brine-influenced and steam-fed shallow wells and surface manifestations.

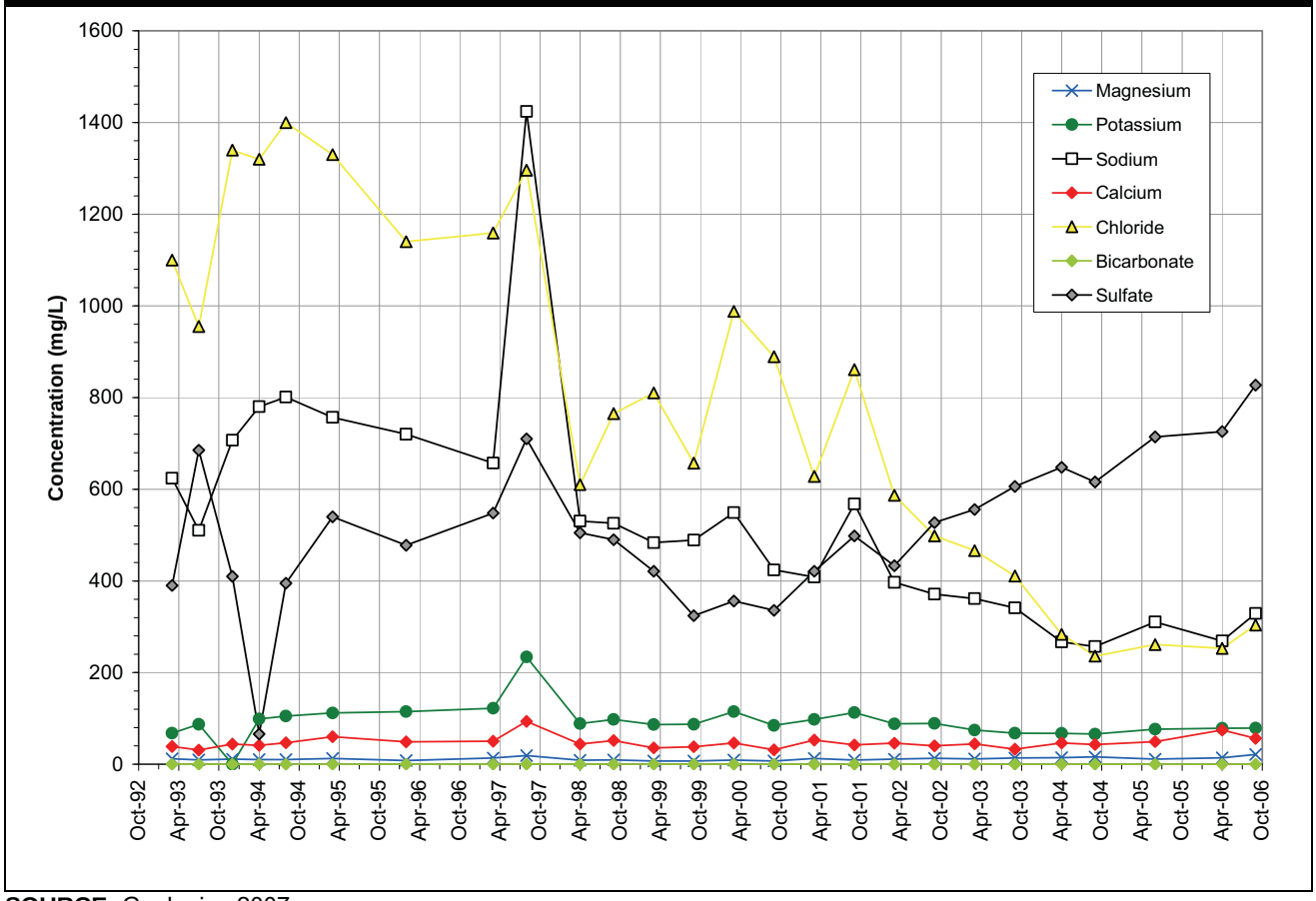
The Navy collects monitoring data at Coso Hot Springs on well temperatures, fluid chemistry and surface manifestations. The data documents temperature increases and expanded steam-related thermal activity in the shallow outflow of the Coso geothermal system. Two decades of systematic temperature surveys in shallow monitoring wells record the steady increase in temperatures in shallow aquifers beyond well established seasonal variations for surface manifestations and shallow wells. While the influence of brine relative to steam in discharge from Nichol Pool (Figure 3.2-13) and the Wheeler areas has recently declined, it appears to have increased since 2000 in Devils Kitchen. Increased temperatures, expanded thermal activity, and geochemical evidence of increasing steam influx have been relatively consistent since 1993; however, with the exception of seasonal and diurnal fluctuations, changes in chemistry, temperatures, water levels and steam flow rates are erratic and appear to have complex sources.

Figure 3.2-12: Sodium Chloride in Surface Manifestations and Shallow Wells at Coso Hot Springs



SOURCE: Geologica 2008

Figure 3.2-13: Variations in Chemistry of Nichol Pool



SOURCE: Geologica 2007

3.2.2 REGULATORY SETTING

Federal

Clean Water Act

The Clean Water Act (CWA) has regulated the discharge of pollutants to waters of the United States from any point source since enacted in 1972. In 1987, amendments to the CWA added section 402(p), which established a framework for regulating non-point source stormwater discharges under the National Pollutant Discharge Elimination System (NPDES). The NPDES stormwater program is described below.

State and Regional

NPDES General Construction Activities Stormwater Permit Requirements

In California, the NPDES Stormwater Program is administered by the California Regional Water Quality Control Boards. Dischargers whose projects disturb 1 or more acres of soil or whose projects disturb less than 1 acre, but are part of a larger common plan of development that in total disturbs 1 or more acres, are required to obtain coverage under the General Permit for Discharges of Stormwater Associated with Construction Activity (*Construction General Permit, 99-08-DWQ*). Construction activities subject to this permit include clearing, grading and disturbances to the

ground, such as stockpiling, or excavation, but do not include regular maintenance activities performed to restore the original line, grade, or capacity of the facility.

The Construction General Permit requires the development and implementation of a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP must list Best Management Practices (BMPs) that the discharger will use to protect stormwater runoff and their placement. The SWPPP must also contain a visual monitoring program, a chemical monitoring program for "non-visible" pollutants to be implemented if there is a failure of BMPs, and a sediment monitoring plan if the site discharges directly to a water body listed on the 303(d) of the Clean Water Act list for sediment.

Local

Inyo County Code Section 18.77

Inyo County Code Section 18.77 regulates water transfers undertaken pursuant to Water Code Section 1810 (Sales of Surface Water or Groundwater by the City of Los Angeles, and the Transfer or Transport of Water from Groundwater Basins Located in Whole or in Part Within). Section 18.77.015 describes the conditional use permit (CUP) requirements:

> "Any person who proposes a transfer or transport of water described in Section 18.77.010. A. shall, prior to the commencement of the water transfer or transport, first apply for and obtain from the County Planning Commission a conditional use permit as provided in Chapter 18.81 of this Code. (Ord. 1004 § 6, 1998: Ord. 943 § 4 (part), 1994.)"

The proposed project requires a CUP (as stated in Chapter 2: Project Description, of this EIR) for the transfer of water from the Rose Valley Groundwater Basin to the Coso Groundwater Basin. That CUP is subject to all of the provisions of Chapter 18.77 of the Inyo County Code.

Section 18.77.045 of the Inyo County Code states:

> "In the event that evidence obtained through the monitoring and/or reporting program, or other evidence, indicates that a water transfer subject to a conditional use permit has unreasonably affected, or has the potential to unreasonably affect, the overall economy or the environment of the county, or that there has been a failure to comply with the provisions of the permit, the county planning commission shall conduct a noticed public hearing into the matter. If at the conclusion of the hearing, the commission finds that an existing water transfer, if continued, would cause an unreasonable effect on the overall economy or the environment of the county, the commission shall modify the provisions of the conditional use permit to the extent that it finds to be necessary to avoid the occurrence of such an effect. If the commission finds that a water transfer, subject to a conditional use permit has unreasonably affected the overall economy or the environment of the county, the commission shall order the implementation of such mitigation measures as it finds to be necessary to reduce the level of the effect to less than significant; in addition, the commission may modify the conditional use permit to the extent that it finds to be necessary to avoid the occurrence of such unreasonable effects in the future."

The Planning Commission may *revoke* the CUP if it finds that the water transfer can not be conducted without having an unreasonable effect on the economy or environment of Inyo County.

Section 18.77.055 of the Inyo County Code allows any party to challenge the ongoing transfer of water by alleging that the permitee is in violation of its permit requirements or that the transfer project is unreasonably affecting, or has the potential to unreasonably affect, the overall economy or environment of Inyo County.

General Plan

The Inyo County General Plan (Inyo County 2001) Conservation and Open Space Element goals and policies relevant to hydrology and water quality are listed below.

- **Conservation and Open Space Element:**
  - Goal WR-1 Provide an adequate and high quality water supply to all users within the County.
  - Policy WR-1.4 *Regulatory Compliance:* Continue the review of development proposals and existing uses to the requirements of the Clean Water Act, LRWQCB, and local ordinances to reduce polluted runoff from entering surface waters.
  - Goal WR-2 Protect and preserve water resources for the maintenance, enhancement, and restoration of environmental resources.
  - Policy WR-2.1 *Restoration:* Encourage and support the restoration of degraded water surface and groundwater resources.
  - Goal WR-3 Protect and restore environmental resources from the effects of export and withdrawal of water resources.
  - Policy WR-3.2 *Sustainable Groundwater Withdrawal:* The County shall manage the groundwater resources within the County through ordinances, project approvals and agreements, ensure adequate, safe and economically viable groundwater supply for existing and future development within the County, protect existing groundwater users, maintain and enhance the natural environment, protect the overall economy of the County, and protect groundwater and surface water quality and quantity.

3.2.3 THRESHOLDS OF SIGNIFICANCE

The project would have a significant impact if it would:

1. Deplete groundwater supplies in a manner that would result in substantial effects to existing groundwater supplies or users
2. Substantially reduce the amount of water available to surface water bodies at Little Lake Ranch and to other areas in the Rose Valley
3. Substantially alter the existing drainage pattern in the project area in a manner which would result in substantial erosion or siltation on- or off-site
4. Cause substantial flooding that could result in damage to life or property
5. Cause a violation of water quality requirements or otherwise degrade existing water quality in the area or impact drinking water and drinking water supplies

These potential impacts are discussed in the following section.

3.2.4 IMPACTS AND MITIGATION

Potential Impact 3.2-1: The potential to deplete groundwater supplies in a manner that would result in substantial effects to existing groundwater supplies or users

Overview of Impacts

The project would include water use during construction of the proposed pipeline. No significant construction-related impacts to the groundwater resources of Rose Valley are anticipated.

Potentially significant impacts to groundwater resources are predicted from operation of the project. Full project development would involve extracting groundwater from the two Hay Ranch wells at a combined total rate of approximately 4,839 acre-ft each year for the planned project duration of 30 years. The principal impact from operation of the project would result from groundwater table drawdown induced by groundwater pumping at the Hay Ranch property. Local groundwater users within Rose Valley may also experience a drop in groundwater level and could be impacted by the project. Mitigation is defined to avoid significant effects (see below). Impacts to groundwater users in the Indian Wells Basin, which receives groundwater underflow from the Rose Valley, would be less than significant, as underflow from Rose Valley is only a small portion of the water budget for the groundwater in Indian Wells Valley.

Lowered groundwater levels could have a significant impact on water availability at Little Lake Ranch, located 9 miles south of the project area. Mitigation has been defined to monitor groundwater levels through the life of the project and to re-equip or re-drill any wells that are impacted by groundwater drawdown caused by the project.

Effects to water levels in Little Lake and the surrounding springs and wetlands are discussed under Potential Impact 3.2-2.

Construction

Construction of the project would consist of installing downhole pumps in the two existing Hay Ranch wells, installing permanent electrical service to the two well heads, and constructing a water delivery pipeline and storage tanks from the Hay Ranch property for approximately 9 miles east, to the Coso geothermal field. Water would be needed primarily for dust control and concrete mixing during construction. Construction is estimated to take approximately 110 days. Daily water needs would be unlikely to exceed 15 truckloads (approximately 45,000 gallons), which can be obtained from wells owned by COC at Coso Junction, or the Coso Ranch south well (located opposite the Coso store). These wells are currently used to provide water by the truck load to the nearby pumice mine operation.

The increased groundwater demand during construction (at 45,000 gallons per day or approximately 30 gpm on a continuous basis) would have no measurable impact on other groundwater users in the valley. The total volume of groundwater (approximately 15 acre-feet) potentially consumed during construction of the project would have no significant impact on water resources in the valley because the amount of groundwater available is several thousands of acre-feet. During the pumping test performed in November and December 2007, about 88 acre-ft of water was pumped and applied to the surface on the Hay Ranch property with no measurable effect to wells off of the Hay Ranch property (see Appendix C1 for pumping test description and results).

The construction contractor may also elect to install a small temporary pump in one of the Hay Ranch wells to supply construction water. The impact of pumping either one of the Hay Ranch wells at a rate of 30 gpm during construction is unlikely to occur off of the property. No other groundwater would be needed during construction. Impacts would be less than significant.

Operation and Maintenance

The principal impacts from operation and maintenance of the proposed project would be from groundwater pumping and subsequent transfer of that groundwater from one basin (Rose Valley) to another (Coso Basin). Potential impacts to groundwater users are discussed below for users within Rose Valley and Indian Wells Valley to the south.

Operation of the substation and associated facilities (buildings), water storage tanks, and pipeline would not have an impact on groundwater supplies beyond the actual groundwater pumping. These project components would create approximately 3 acres of new impervious surface; however, given

the vast amount of undeveloped acreage in the area, recharge to groundwater would not be significantly impacted. The substation would include a MEER that may have a bathroom facility. A few gallons of water per day would be required for the bathroom facility and would likely be stored in a small tank near the facility and produced by the Hay Ranch wells or another nearby supply (e.g., the Coso Store well, or the Coso Ranch well, or purchased). Water use for domestic purposes at the facilities would not significantly impact groundwater supplies in the project area.

Potential Impacts to Groundwater Users within Rose Valley. Groundwater pumping, as proposed, could result in reduced groundwater levels in Rose Valley. The number of existing groundwater users in the valley is limited due to limited development in the area. An estimated 40 acre-ft/yr of groundwater is currently produced from groundwater wells in Rose Valley. Dunmovin area may have as many as 30 domestic wells. Other wells include those owned by LADWP, Cal-Pumice, Coso Ranch (north and south well), northern and southern Coso Junction store well, and the Caltrans well at Coso Junction. At the south end of Rose Valley, the Red Hill well on Cinder Road is believed to be used for domestic purposes. Wells on the Navy property in Rose Valley, including the Lego well, well G-36, and well 18-28. There are also water wells on Little Lake property. Not all of the wells in the valley are in use.

Numerical groundwater flow modeling analysis was conducted to evaluate potential impacts of project operation on groundwater levels throughout the valley. The flow modeling analysis is described in Appendix C2. A four-layer model was constructed, with Layers 1 and 2 representing recent alluvial sediments, Layer 3 the Coso Lake Bed, and Layer 4 the Coso Sand unit. The upper layer is simulated as an unconfined aquifer and the three lower layers simulated as confined units. In general, Layers 1 and 2 have substantially higher values of hydraulic conductivity in the model and most of the groundwater flow occurs in these upper layers.

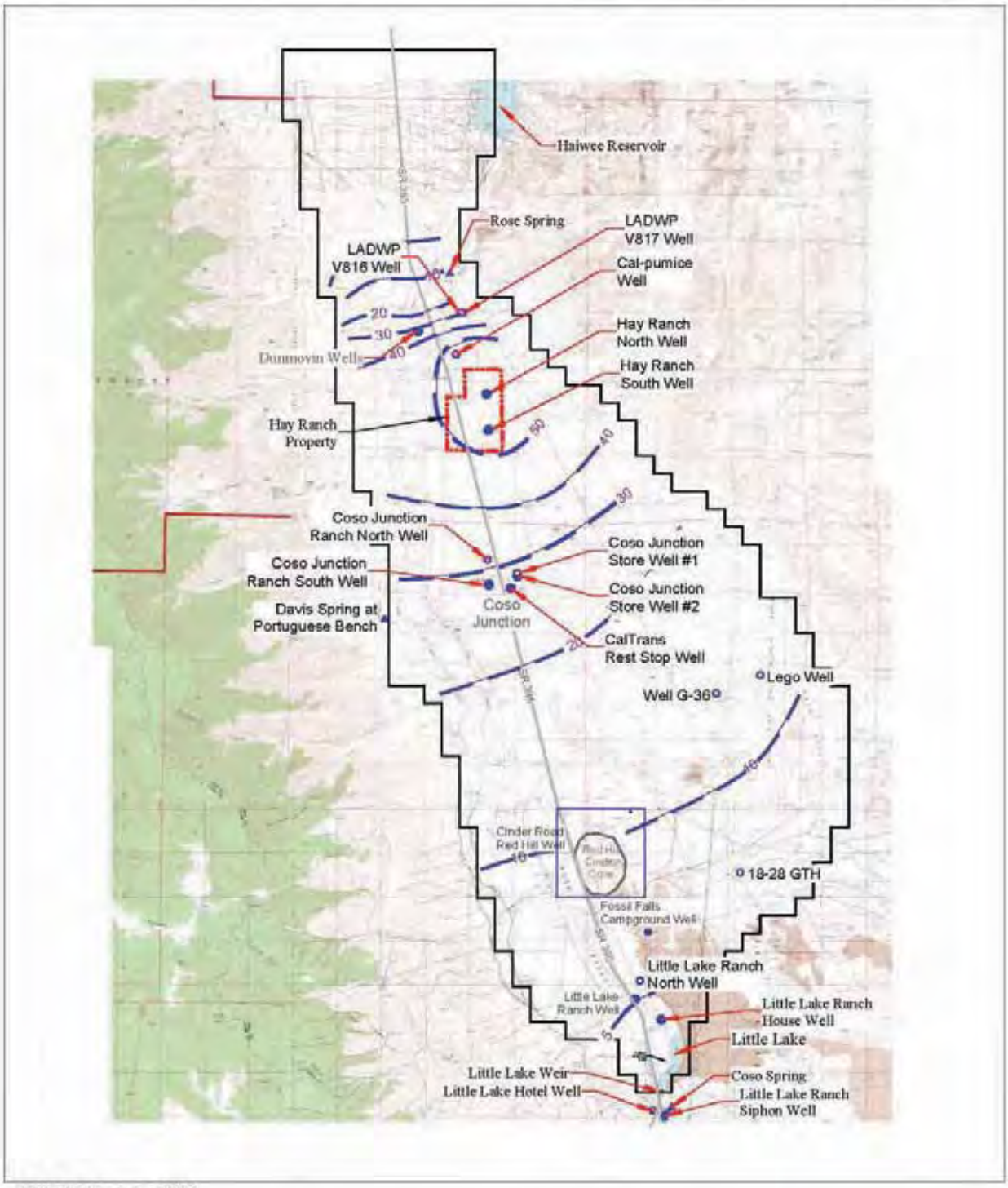
The predicted groundwater table drawdown developed after 30 years of pumping the Hay Ranch wells at the full project development rate of 4,839 acre-ft/yr is depicted in plan view on Figure 3.2-14. Predicted drawdown in groundwater levels in various wells after full project development is shown in Table 3.2-5.

The range in predicted drawdown impacts reflects uncertainty in assumed values for aquifer specific yield (a measure of the aquifer's ability to release groundwater from storage); low specific yield values result in greater drawdown in groundwater levels that would occur and would be observed sooner than if the aquifer has a high specific yield. Higher specific yield values result in less drawdown with time and less drawdown farther from the pumped wells. There may be additional uncertainty associated with the existing limited knowledge of the transmissivity, recharge, and evapotranspiration values.

These estimates of predicted drawdown may be conservative because of several conservative assumptions used in the model:

1. The groundwater flow into Rose Valley from Owens Valley is presumed to be underestimated (see water budget discussion associated with Table 3.2-3)
2. The model does not include any flow from Coso Basin, although the isotopic studies showed that there is evidence of geothermal fluids in the Little Lake area
3. The estimate of evapotranspiration from the Little Lake area is high
4. The model assumes a low precipitation recharge rate from the Sierra Nevada mountains west of the valley
5. The model neglects potential precipitation recharge from the Coso Range on the east side of the valley and neglects precipitation recharge falling directly on the valley floor
6. The model uses a low estimate for groundwater underflow from Owens Valley to the north

Figure 3.2-14: Predicted Groundwater Table Drawdown After 30 Years at Full Project Development Rate of 4,839 acre-feet/year



SOURCE: Geologica 2008

LEGEND

- Spring or Siphon Well
- Pumping Well
- Out-of-Use Well
- Groundwater Drawdown Contour, ft
- Boundary of Numerical Model

Approximate Scale in miles

0 1 2

MHA ENVIRONMENTAL CONSULTING An RMT Business

Table 3.2-5: Predicted Maximum Drawdown in Wells in Rose Valley at Full Pumping Rate for 30 Years

Location	Distance from Hay Ranch Wells	Predicted Maximum Drawdown
Wells in Dunmovin and LADWP wells	1.5 miles north	25 to 55 feet
Coso Junction wells	2 miles south	20 to 50 feet
Cinder Road/Red Hill well	6.5 miles south	7 to 20 feet
Little Lake Ranch North well	8.5 miles	4 to 11 feet

In contrast, uncertainties in the value of specific yield could cause the predicted drawdown values to be somewhat greater than predicted. Uncertainties in transmissivity, recharge and evapotranspiration could cause the predicted drawdown to be either higher or lower. The effect of uncertainties in the model results is discussed later.

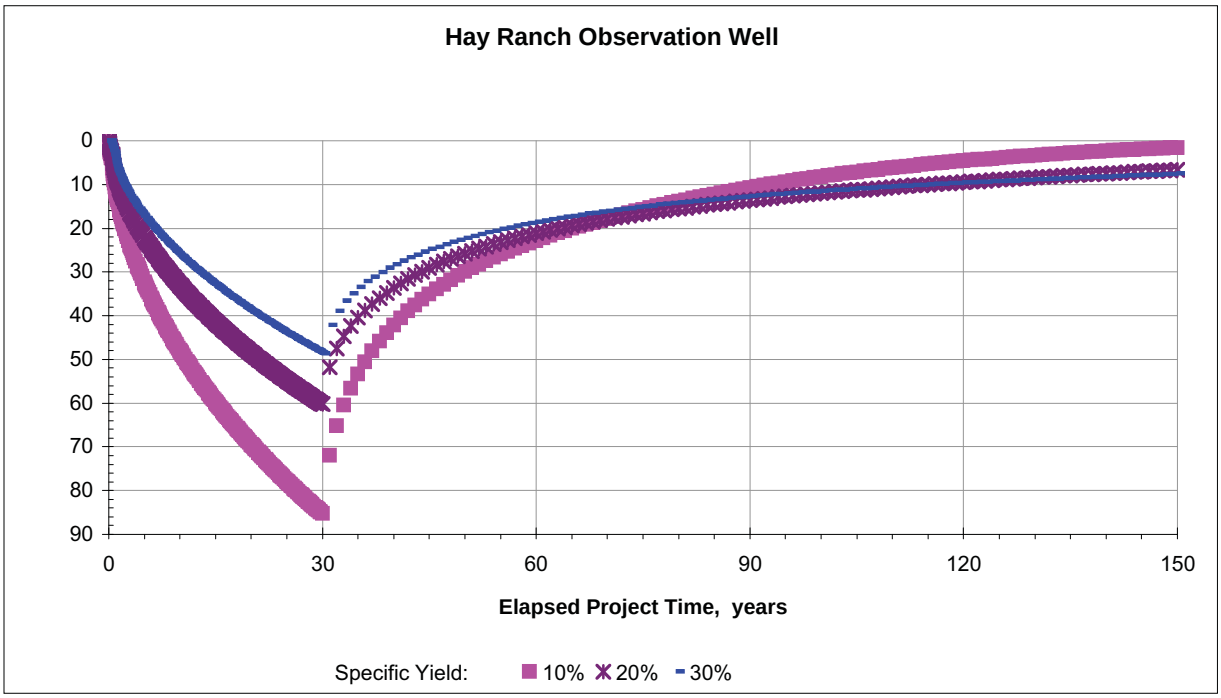
Groundwater-yielding sediments encountered in Rose Valley consist primarily of sand and gravel interbedded with clays. Most of the groundwater is expected to be produced from the more readily drainable sand and gravel horizons. Published values of specific yield (Johnson 1967; Morris and Johnson 1967) range from 2 percent for clay to 35 percent for well-graded gravels. Because specific yield could not be determined from the pumping test data, a range of values corresponding to expected high, medium, and low values of 30, 20, and 10 percent for model Layer 1 were used in the groundwater modeling that was conducted for this impact analyses. The deeper hydrostratigraphic units (model Layers 2, 3, and 4) were represented by lower values of storage coefficient (specific yield), which reflect confined aquifer conditions (see Appendix C-2 for a more complete discussion).

Groundwater table drawdown would increase with time following startup of the project. The modeling results indicate that, depending on aquifer specific yield, the impact of pumping at Hay Ranch would take more time to develop at locations farther from Hay Ranch. At locations farther from Hay Ranch, the maximum drawdown may develop after pumping at Hay Ranch has stopped. Figure 3.2-15 shows that the maximum drawdown on the Hay Ranch property is predicted to occur at the end of the 30 year project pumping period, whereas the time at which the predicted maximum drawdown occurs is delayed for areas farther south of Hay Ranch. The maximum predicted drawdown at wells at Little Lake (9 miles south of Hay Ranch) is expected to occur up to 30 years after pumping at Hay Ranch stops. This delay period is also dependent on specific yield. The delay would be shorter for lower specific yield values and longer for higher specific yield values.

The predicted changes in groundwater table drawdown over time in wells in the community of Dunmovin, Coso Junction, the Red Hill well on Cinder Road, and Little Lake Ranch North are shown in Figure 3.2-15.

Groundwater pumping and transfer, as proposed, would have a potentially significant impact on other groundwater users in Rose Valley by lowering the groundwater table in the vicinity of their wells and therefore potentially inhibiting access to groundwater. Due to the low level of predicted groundwater table drawdown (less than 10 feet), water supply wells at the south end of Rose Valley may not need any equipment changes. Although well construction details were not available for most of the wells in the valley, most of the wells appear unlikely to need to be deepened because the maximum drawdown predicted off the property is less than 40 feet and most wells have a water column of 100 feet or more. However, for wells in the Dunmovin area and in Coso Junction, existing pumps might have to be set at lower depths, or existing pumps might need to be replaced with pumps with greater lift capacity.

Figure 3.2-15: Predicted Groundwater Elevation Changes with Time in Wells in Rose Valley for Pumping at 4,839 Ac-Ft Per Year for 30 Years



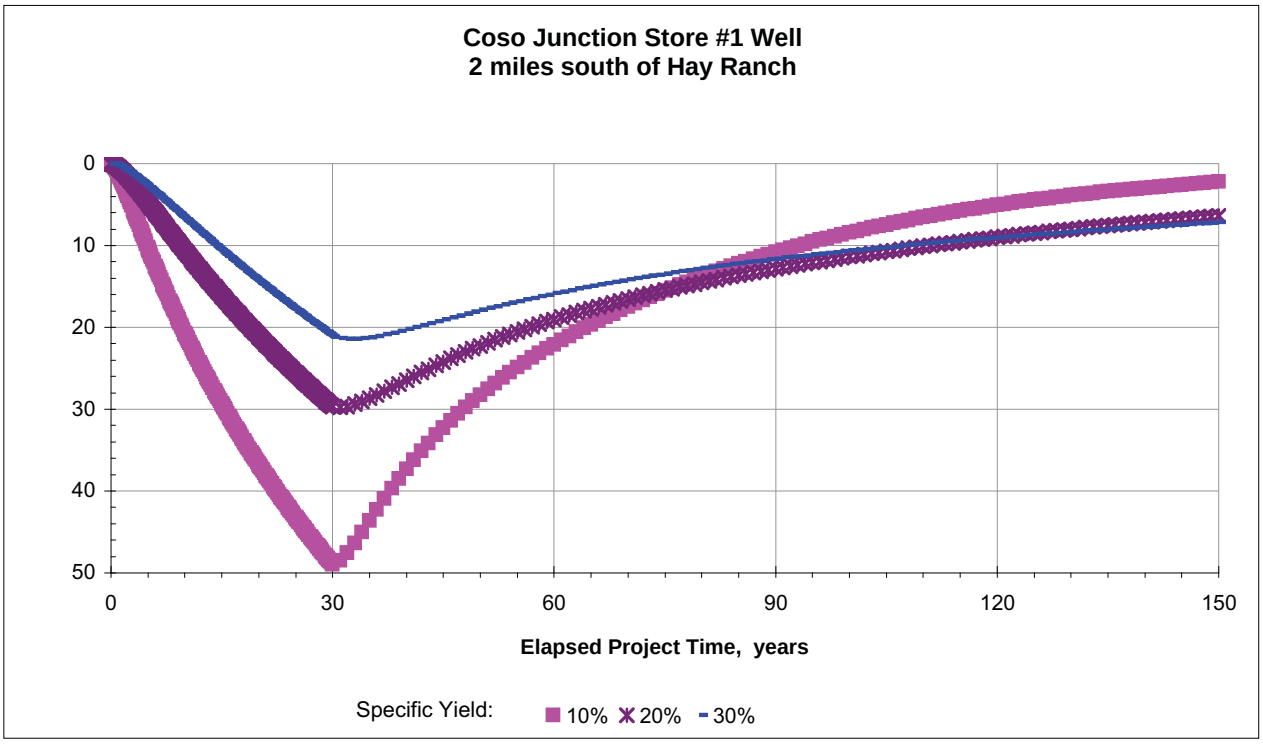
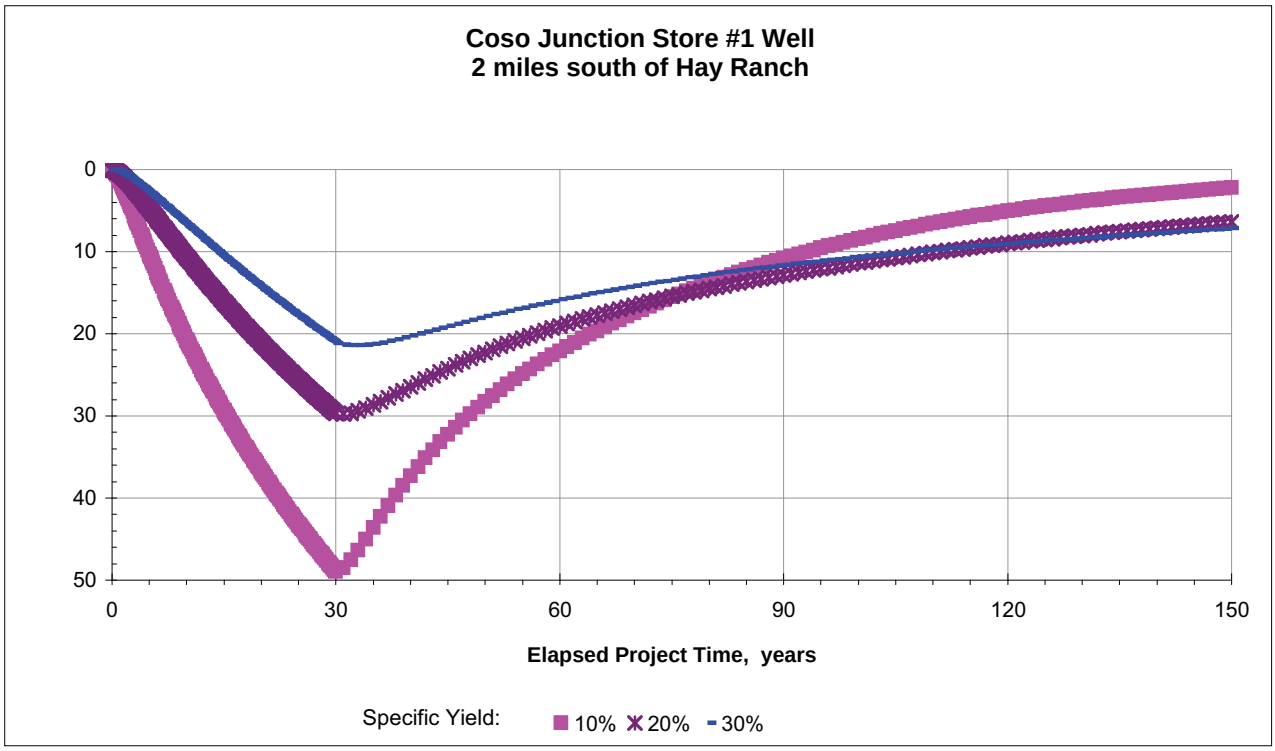
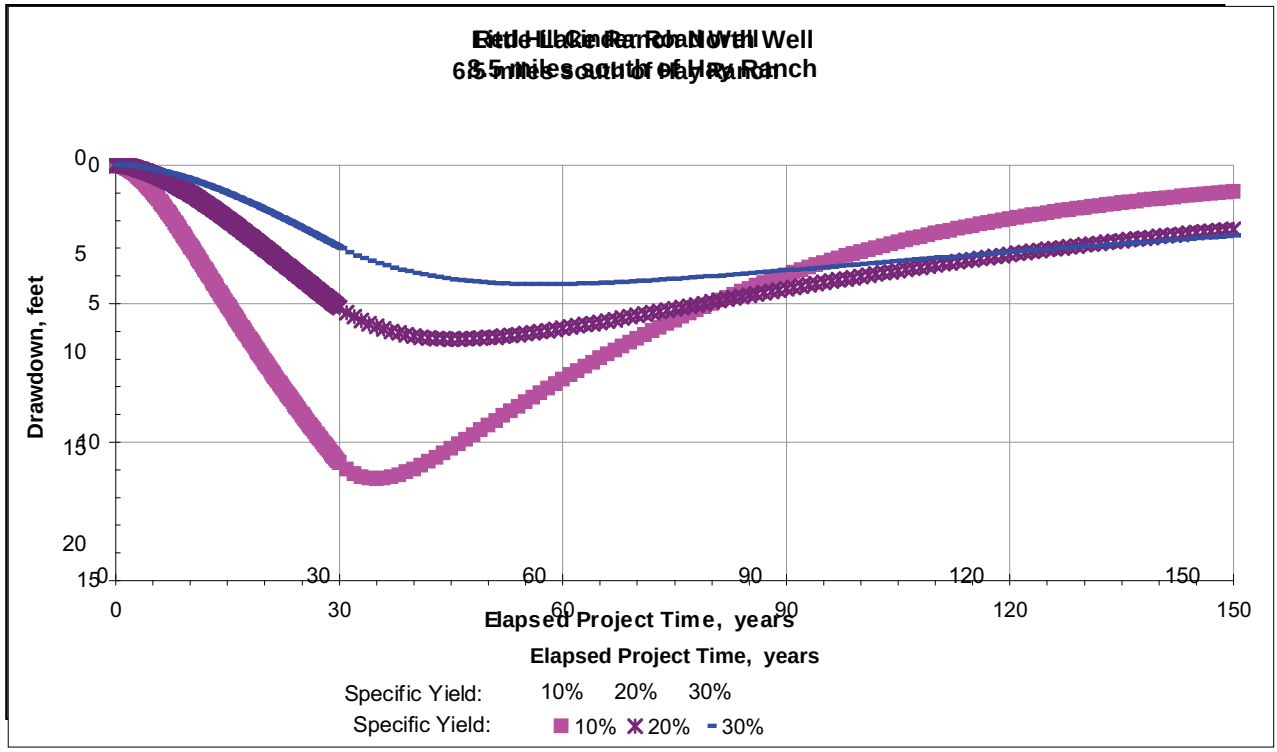


Figure 3.2-15 *(Continued)*: Predicted Groundwater Elevation Changes with Time in Wells in Rose Valley Pumping at 4,839 Ac-Ft Per Year for 30 Years





SOURCE: Geologica 2008

Mitigation described below requires that the applicant fund any well adjustments through the life of the proposed project for any existing wells that lose their current functionality as a result of the proposed project. The mitigation would minimize impacts of the proposed project on access and use of existing wells in the Rose Valley to less than significant levels. Monitoring would also occur to track groundwater drawdown as a result of the proposed project in order to determine when and if mitigation would be needed.

> **Hydrology-1:** The project applicant shall finalize and implement the Draft Hydrological Monitoring and Mitigation Program (HMMP) included in Appendix C4 of this EIR.
>
> **Hydrology-2:** Mitigation for effects to groundwater wells in Rose Valley shall depend upon the specific characteristics of each well, and the use of the well. The applicant shall use monitoring data and the numerical groundwater flow model described in Appendix C2 to track groundwater levels throughout the valley. The applicant shall work with the County Water Department to identify wells that may be affected by groundwater drawdown as the project progresses. The evaluation of wells depths and uses in the Rose Valley as compared with groundwater drawdown shall be made semi-annually and reported to the Inyo County Water Department. The owner of any wells that may potentially be impacted within the six months after an evaluation shall be contacted by the applicant to assess the need for additional pumping equipment on the well or deepening of the well. The applicant shall be responsible for the cost of equipping or deepening wells that are impacted by groundwater drawdown as a result of the proposed project. The applicant shall also evaluate any wells that are brought to the attention of the applicant by the user to evaluate if groundwater drawdown from the proposed project is impacting the well. If it is determined by the County or by the applicant (using well monitoring data and modeling) that the well in question is being impacted by the proposed project, the applicant shall fund the necessary adjustments to the well to secure the previous uses of the well. Disputes as to the cause of well water drawdown or appropriate corrective measures shall be resolved by the County.

Potential Impacts to Groundwater Users in Indian Wells Basin

The project would result in a reduction in the amount of groundwater flowing south to the Indian Wells Valley. Impacts to groundwater users in Indian Wells Valley, which receives groundwater underflow from the Rose Valley, would be less than significant, as discussed earlier. Underflow is only a small portion of the groundwater budget in Indian Wells Valley. The predicted reduction in groundwater underflow to Indian Wells Valley ranges from 377 acre-ft/yr at a specific yield of 30% to 1,300 acre-ft/yr at a specific yield of 10% at the full project development rate and 30 year project duration. These values are less than 3% of the total recharge of 46,000 acre-ft per year estimated by Williams (2004) for the Indian Wells Valley. If mitigation is implemented, for example in the form of reducing or ceasing Hay Ranch pumping after 1.2 years of pumping (discussed in Potential Impact 3.2-2), even less impact to groundwater users in Indian Wells Valley is predicted.

Decommissioning

Decommissioning would involve removing above ground project components, including the tanks and the equipment on the Hay Ranch property, and abandoning the pipeline in-place. Pumping of the Hay Ranch wells would terminate and no more water would be transported out of the basin as part of the proposed project. Impacts to groundwater drawdown would cease in much of the valley as the aquifer begins to refill; however, due to the lag effect in the more distant portions of the valley, such as Little Lake, some additional drawdown will occur for a few years following cessation of pumping. The lag effect could continue for as much as 30 years after pumping before the maximum drawdown is reached, based on modeling results. Groundwater levels would eventually rise throughout the valley; however due to the lag effect discussed above, groundwater levels in the more distant areas, such as the south end of the valley, would recover more slowly and could take more than 30 years to recover fully after pumping ceases. The rate of groundwater table elevation recovery also depends on aquifer specific yield; as depicted on Figure 3.2-15, groundwater elevation

would recover more quickly if specific yield is low (10%) than if it is high (30%). Groundwater recovery throughout the valley would occur more rapidly if less groundwater was withdrawn for the project (e.g., if the project was terminated early or Hay Ranch pumping rates were reduced before the end of the 30 year project life). Impacts of decommissioning itself would be less than significant, although there would be a delayed recovery to the cessation of pumping in many areas.

Potential Impact 3.2-2: The potential to substantially reduce the amount of water available to surface water bodies at Little Lake Ranch and to other areas in the Rose Valley

Overview of Impacts

Construction would not have impacts on surface waters or springs because only a relatively small amount of water is needed for dust suppression and other construction activities. There are no surface waters near the project site that would be used as a water supply for construction or that could be impacted by construction.

During the operation phase and post-operation recovery phase, the principal potential impacts to surface water flows include possible reduction or elimination of spring or siphon well/spring flows in certain locations and the reduction in water available to Little Lake Ranch.

Because they are located at much higher elevations than the groundwater table in the Rose Valley aquifer, the Tunawee Canyon and the Davis spring/siphon well at Portuguese Bench, as well as Rose Spring, located 2 miles north of the proposed project are, are unlikely to be impacted by the proposed project. However, numerical modeling analysis presented in Appendix C2 indicates long term operation of the project could impact water levels and surface water discharge on the Little Lake Ranch property.

Water availability at Little Lake Ranch could be impacted by the proposed project. The HMMP (as described in mitigation measure Hydrology-1) would be implemented to monitor and identify potential effects to water availability at Little Lake Ranch.

Mitigation for the effects of pumping at Hay Ranch is defined in Mitigation Measure Hydrology-4 and includes:

1) Monitoring and recalibration of the groundwater model to improve model predictions. The model recalibration shall be conducted within the first year, and then at a frequency of every 5 years or less for the duration of pumping operations, as needed or as directed by the Inyo County Water Department. The recalibration shall be conducted sooner if actual drawdown in two or more monitored wells is at least 0.25 feet higher than predicted by the model for those locations. New predicted drawdown values shall be calculated based on the recalibrated model, and an evaluation shall be made whether reduced pumping rates and/or duration is necessary.
2) Reducing pumping rates and/or duration after project startup as determined by the Inyo County Water Department based on a more accurate model and triggers defined to prevent the threshold of significance from being reached.

Mitigation would minimize potential impacts to water availability at Little Lake Ranch and surrounding surface waters, wetlands, and springs to less than significant levels.

Construction

Construction of the project is unlikely to impact surface waters, springs, or surface water discharge rates at Little Lake because of the short duration (110 days), relatively small amount of groundwater potentially needed for construction related purposes, and distance (over 9 miles) from the project well locations. Groundwater may be used for dust suppression at an estimated maximum of 15 acre-

feet over the course of the project construction. Pumping tests in November and December 2007 withdrew about 88 acre-feet of water and applied it to the surface with no discernable impact to surface springs or waters off of the Hay Ranch property. Construction water use would not impact water levels in surface waters or springs.

Operation and Maintenance

The principal impact in Rose Valley from operation and maintenance of the proposed project would be from groundwater table drawdown off the property resulting from removing groundwater from the Hay Ranch property and transporting it outside the Rose Valley groundwater basin (to the Coso Basin). Operation of the substation and associated facilities (buildings), water storage tanks, and pipeline would not have an impact on surface water supplies unrelated to groundwater pumping.

Springs, siphon wells, and surface waters in the project region include:

- Tunawee Canyon Spring at Portuguese Bench
- Davis Spring and siphon well at Portuguese Bench
- Rose Spring
- Little Lake, springs, and siphon well

Potential Impact to Springs. The Tunawee Canyon and the Davis spring/siphon well at Portuguese Bench would not be impacted by the proposed project because they are located at much higher elevations than the groundwater table in the Rose Valley aquifer. Portuguese Bench is located approximately 600 feet in elevation above the groundwater table level at the Hay Ranch property. The well at the Davis Ranch was monitored during the November/December 2007 pumping tests and no effects were identified (see Appendix C1). Given the artesian flow at the wells on Portuguese Bench, proximity to the Sierra Nevada, and elevation of over 600 feet above groundwater level at Hay Ranch, water supplying the wells at Portuguese Bench is not hydrologically dependent on the water in the Rose Valley. The springs and wells on Davis Ranch and Portuguese Bench would not be impacted by the proposed project.

Rose Spring, located approximately 2 miles north of the Hay Ranch property at an elevation of 3,580 feet amsl ,is apparently perched groundwater and is approximately 300 ft above the local elevation of the groundwater table in the aquifer. Because it is perched far above the water table, it is unlikely to be impacted by the proposed project. The source of water for the spring is derived from Sierra Nevada mountain front precipitation and groundwater underflow from Owens Valley, neither of which is likely to be impacted by pumping at Hay Ranch. Recent monitoring indicates that there is currently no surface water flowing at Rose Spring (EREMICO 2008).

Potential Impacts to Water Availability at Little Lake Ranch. Impacts to Little Lake Ranch could occur through substantially reduced water availability to Little Lake and/or through substantially reduced water flow to the lower ponds.

Surface waters at Little Lake Ranch could be impacted by operation of the proposed project. Surface water flows on the Little Lake Ranch property are sustained entirely by groundwater inflow that rises to the surface in the area. The source of the groundwater that discharges to Little Lake is estimated to be primarily (more than 80%) from Sierran recharge to Rose Valley coming from the west, in addition to some groundwater upwelling from the Coso Basin to the east (as much as 250 acre-ft/year) and some amount of underflow from the north of Rose Valley (an estimated 898 acre-ft/yr).

The groundwater beneath the Hay Ranch property primarily originates as precipitation recharge in the Sierra Nevada Mountains north and west of the property with some contribution from groundwater underflow from north of Rose Valley and upwelling geothermal water from the Coso Range. The groundwater elevation and flow rate towards Little Lake Ranch could be reduced by

pumping at Hay Ranch. Flow rates towards Little Lake Ranch could be reduced because pumping at Hay Ranch would capture some of the groundwater flow from Owens Valley and the Sierran recharge in the north end of the valley. Capture of water at Hay Ranch could create northerly groundwater table gradients near Hay Ranch that could reduce the natural southerly groundwater gradients towards the south end of the valley where Little Lake is located.

Table 3.2-6 provides a breakdown of the sources of water captured by the Hay Ranch wells at the full project development rate of 4,839 acre-ft/year, based on modeling results. The results indicate that capture of groundwater at Hay Ranch that normally flows toward the Little Lake Gap would reduce groundwater elevations and groundwater flow rates towards Little Lake. Further explanation of the model is provided in Appendix C2.The model results indicate that at the full design rates, the project would reduce groundwater flow and table elevation on the Little Lake property.

Relationship between Groundwater and Surface Water at Little Lake Ranch. Groundwater table drawdown at the Little Lake Ranch property would likely reduce water available to the lake, which could potentially cause water levels in the lake and ponds to fall. One stated goal of the 2000 Habitat Restoration and Improvement Plan (ULLR 2000) is to protect and increase the effective use of surface water on the ranch. The plan outlines methods to further increase the property's wetland acreage and total surface area of impounded water through better control of water flowing through the property. A substantial decrease in the lake size due to reduced availability of groundwater would negatively impact habitat restoration efforts and would be considered a potentially significant effect.

Bauer (2002) found that the groundwater elevation in the well on the north shore of Little Lake (Little Lake North Dock well) was consistently 3 feet higher than the lake level, indicating that the lake gained water from the aquifer year-round. These data suggest that groundwater table drawdown of 3 feet or more could reverse the direction of water exchange such that the lake would begin losing water to the aquifer and cause a reduction in surface area. There is about 1 foot of natural variation in groundwater level at the North Dock well (Bauer 2002).

Table 3.2-6: Sources of Water Captured by Hay Ranch Wells after 30 Years of Pumping at full Project Rate of 4,839 Acre-ft/yr

	Specific Yield Values Used in Model		
	10% (acre-ft/yr)	20% (acre-ft/yr)	30% (acre-ft/yr)
Increased Groundwater Underflow from the North (Owens Valley)	26	6	3
Soil Pore Drainage (Aquifer drawdown)	3,071	3,994	4,343
Reduced Groundwater Underflow to Indian Wells Valley from Southeastern Rose Valley	50	18	8
Reduced Evapotranspiration at Little Lake	379	183	107
Reduced Groundwater Discharge through Little Lake Gap to Indian Wells Valley	1,313	638	377
TOTAL	**4,839**	**4,839**	**4,839**

NOTE: Water budget components calculated from numerical model output files using Groundwater Vistas Mass Balance audit feature.

SOURCE: Geologica 2008

The numerical modeling results predict that groundwater table drawdown will increase with time following startup of the project. The modeling results indicate that, depending on aquifer specific yield, the impact of pumping at Hay Ranch takes greater time to develop at locations farther from Hay Ranch. At locations farther from Hay Ranch, the maximum drawdown may develop after pumping at Hay Ranch has stopped. The maximum drawdown on the Hay Ranch property near the production wells is predicted to occur at the end of the 30 year project pumping period, whereas the predicted maximum drawdown at Little Lake, 9 miles south of Hay Ranch, may not appear for up to 30 years after pumping at Hay Ranch stops (as shown on Figure 3.2-15). This delay period is also dependent on specific yield and is shorter for low specific yield and longer for high specific yield. The predicted changes in groundwater table drawdown at the northern end of Little Lake (North Dock well) with time during and after the 30 year project life are shown in Figure 3.2-16. The currently predicted drawdown at Little Lake North Dock well for full project pumping at a rate of 4,839 ac/ft per year for 30 years ranges from 3 to nearly 8 feet depending on assumed specific yield. Drawdown greater than 3 feet could result in a reverse in the natural flow pattern and could drain the lake, which would be a significant impact. Even drawdowns of less than 3 feet in the vicinity of Little Lake could cause a reduction in lake level and the surface area of the lake because groundwater flow to the lake would decrease as the hydraulic gradient to the lake decreased. A reduction in the amount of groundwater discharging to the lake could cause the water budget in the lake to be in deficit, potentially resulting in a significant drop in lake level and reduction in surface water area, which would be considered a significant effect.

Groundwater Flow Reduction towards the Little Lake Gap. Pumping as proposed at Hay Ranch could also result in reduction in the amount of groundwater flowing towards Little Lake Gap. Groundwater discharge towards the Little Lake Gap would be reduced from the current estimated value of 4,200 acre-ft/yr to between 2,500 and 3,700 acre-ft/yr at the full project pumping rate (4,839 acre-ft/yr) and duration (30 years). The effect of full project development on water table level in the vicinity of Little Lake is shown on Figure 3.2-17.

A reduction in groundwater flow could also impact the discharge rates from the lake, which currently flows over the weir into the lower pond areas during the winter and spring months. A reduction in groundwater flow could also reduce the discharge rate of water from the lower siphon well and Coso Spring, located about ¼ mile south of the Little Lake weir. The spring and siphon well are about 20 feet lower in elevation than the northern end of the lake, so groundwater drawdown here would be much less than in the northern end of the lake (refer to Appendix C2). Because of the damming of Little Lake, the water table elevation is somewhat buffered below the lake, and the springs tend to flow year round, even when the lake is not discharging over the weir.

The Little Lake Ranch habitat restoration effort receives, on average, less than 25% of the water it uses for irrigating the lower property from discharge from Little Lake. The bulk of the water used for downstream restoration efforts comes from Coso Spring and the siphon well. Data from Bauer (2002) indicates that, when the lake stops discharging over the weir, the groundwater continues to discharge from the spring and siphon well. In 1997, there were 3 consecutive summer months when there was no downstream flow from Little Lake. During that time, Coso Spring had its highest monthly flows (2,000 acre-ft/yr). If the Hay Ranch project causes reduction in groundwater flows towards Little Lake, it will reduce the amount of groundwater coming to the surface on the Little Lake Ranch property. As a result, the discharge rate from Little Lake would likely decrease and groundwater that previously surfaced at the lake would likely surface farther south on the property at the siphon well and Coso Spring (increasing the proportion of water discharging from the spring and siphon well compared to the lake).

Figure 3.2-16: Predicted Groundwater Table Drawdown at the North End of Little Lake Pumping at 4,839 Ac-Ft Per Year for 30 Years

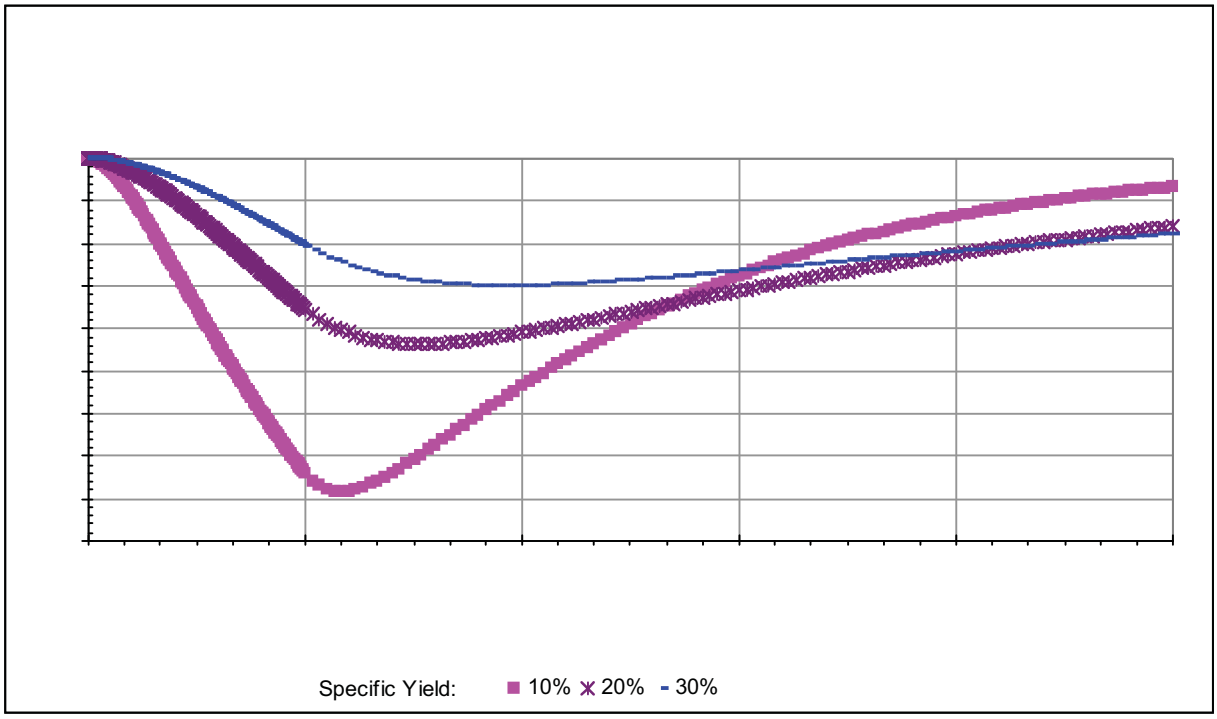
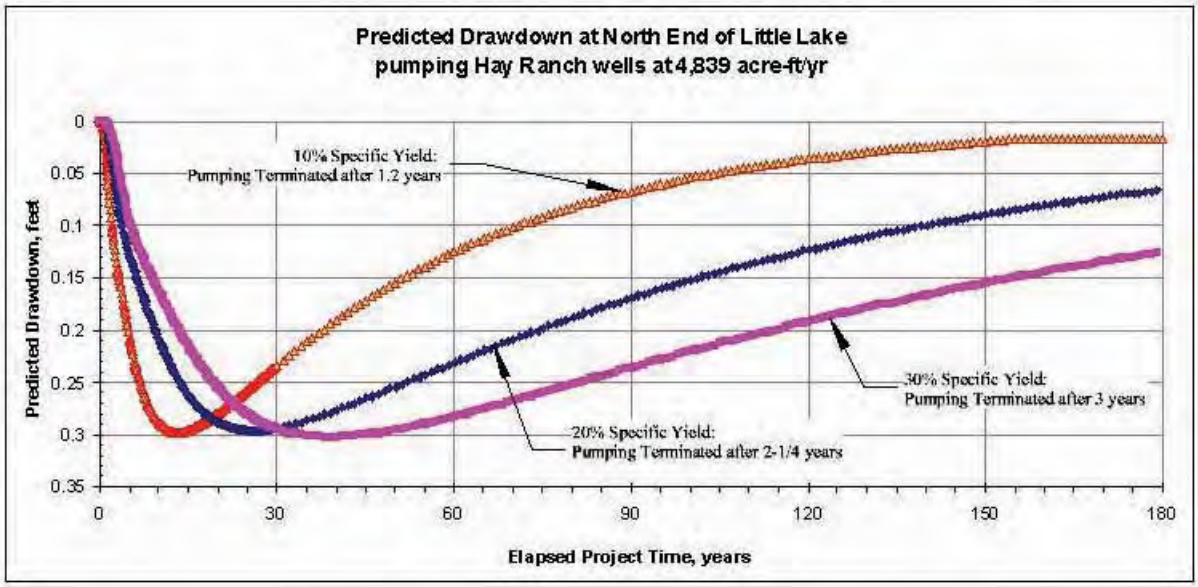


Figure 3.2-17: Early Pumping Termination (1.2 years) Scenario Results



The amount of groundwater surfacing on the property could be reduced substantially under full pumping rates and project duration. A relatively small reduction in the flow rate and overall saturated thickness of the aquifer caused by water table lowering could cause water that previously surfaced to remain below ground. Reduced groundwater flow rates through the lower part of the property would reduce the amount of water that Little Lake Ranch would have to perform their restoration efforts, which could be considered a significant impact.

Definition of a Significant Impact to Water Availability at Little Lake Ranch. Defining thresholds of significant effects to the environment by attempting to measure or predict those effects on vegetation around Little Lake Ranch was considered and rejected. The Little Lake area is highly manipulated. Water levels of the Little Lake reservoir are manually controlled. The vegetation surrounding the area south of Little Lake is manipulated by removing undesirable species, planting others and by moving water to various areas where managers intend to promote vegetation. As a result, there is no natural background condition against which to measure effects. Additionally, by moving water around the property, vegetation may be encouraged in areas not currently highly vegetated and discouraged in areas now heavily vegetated if management objectives for the restoration project shift. Therefore, by necessity, it is most appropriate to emphasize measuring impacts to the amount of water that is available to the restoration project, rather than biological indicators.

The potential effect of groundwater pumping at Hay Ranch includes reduced groundwater flows towards the Little Lake property. This could result in a reduction in water available in the lake as well as in the downstream pond areas. If the project were to result in a substantial decrease in water available to Little Lake Ranch, the project would have a significant impact. Identifying the connection between groundwater withdrawal on the Hay Ranch property and effects on surface water and water availability at Little Lake Ranch is difficult given current limitations in the understanding of the aquifer and groundwater system in the Rose Valley. The hydrologic model and existing data on the relationship between groundwater levels and water levels in Little Lake provide the best scientific basis, at present, for determining how pumping could impact the lake.

Pumping would result in a propagation of groundwater drawdown through the Rose Valley over time. Even after pumping ceases, effects would continue to propagate through the valley. In order to determine project effects, a significant impact at Little Lake must first be defined and then related to groundwater pumping and corresponding groundwater level drawdowns throughout the valley.

A benchmark of no more than a 10% decrease in discharge to Little Lake has been determined to be the “tolerance” level at the lake in order to prevent significant impacts to water availability at the lake. This groundwater flow rate reduction trigger level of 10% has been set such that the observed variation in flow rates at Little Lake would remain largely within the natural envelope already experienced on the property. Groundwater table elevations and gradients in the area vary seasonally. Bauer (2002) found that for three months of 1997 discharge from Little Lake ceased. A reduction in groundwater discharge to the lake of up to10% may extend the period that water does not flow from the lake, but during that timeframe water would still be expected to flow from the siphon well and Coso Spring. Coso Spring currently supplies water to the lower ranch area 75% of the time and, in particular, when overflow stops from Little Lake (Bauer 2002).

The lower pond areas, south of Little Lake, must also receive water to maintain the wetlands. The outflow from the spring, siphon well, and the lake that is not evaporated or consumed by plants infiltrates back into the ground. The amount of water estimated to be reentering the aquifer at the south end of the property may be as much as 3,000 acre-ft/yr, which could be manipulated to create more surface water in the lower ponds. A 10% maximum decrease in groundwater discharge to Little Lake would still allow for the vast majority of the groundwater to be available for creation of surface water features (e.g., ponds) prior to infiltration back into the aquifer. No surface waters currently exit the Little Lake Ranch property (i.e., all water entering the property infiltrates back into the ground, evaporates, or is transpired by plants on the property). Restoration efforts outlined in the 2000 plan

focused on methods to capture currently flowing water prior to its infiltration back into the ground at the south end of the property.

The habitat restoration/creation efforts at Little Lake have been designed for large scale fluctuations in water availability. If the proposed project does not reduce groundwater levels by more than 10%, then it is expected that water would flow from the siphon well and Coso Spring such that downstream areas would have enough water to maintain the manipulated wetland habitats on the property. Flow over Little Lake weir may decrease or cease for a longer period of time than it does now on average. The habitat between the weir and the siphon well is usually subject to a period of ceased flows from the lake (Bauer 2002) and is, therefore, adapted to it. As long as groundwater levels fell just a few inches in this area, plants could grow deeper roots to adapt. When water begins to flow again, the area would again inundate and the wetland plants would thrive again. A 10% or less decrease in flows would allow for continued maintenance of wetland plants and habitat restoration efforts.

The project as proposed would cause a greater than 10% decrease in groundwater inflow to Little Lake based on the existing data and results of the existing model. This would be considered a significant impact. Mitigation includes establishing monitoring points and trigger levels throughout the valley such that, if actions were taken when those levels were reached, they would prevent Little Lake from ever experiencing more than a 10% loss in water availability due to groundwater pumping at Hay Ranch

Mitigation and Monitoring. The project as proposed is expected to cause a significant impact to Little Lake Ranch surface waters based on the results of the existing model and existing data on the relationship between groundwater levels and lake water levels. Based on existing knowledge of the Little Lake area and the groundwater system in the area, triggers throughout the valley that would indicate an eventual 10% decrease in flow to the lake, can be established using the model. Mitigation includes establishing monitoring points throughout the valley that if actions were taken when those levels were reached, would prevent Little Lake from ever experiencing more than a 10% loss in water availability due to groundwater pumping at Hay Ranch.

The trigger points are established based on the groundwater drawdown level that could cause a significant impact at Little Lake. Current data suggests that the groundwater aquifer is 3 feet higher than the lake level. A 10% decrease in head would result in 10% decrease in water flow to the lake. This is currently believed to be 0.3 feet of groundwater drawdown at the north end of Little Lake.

This 0.3 feet of drawdown at the Little Lake North Dock well is ***not*** the main monitoring point, but a calibration point for the model. The calibration point is necessary to establish the equivalent drawdown in areas up-valley, such that if those triggers up-valley are reached, mitigation must be implemented to prevent an eventual decrease of groundwater flow to Little Lake greater than 10%. The North Dock well is a complex location for monitoring due to its proximity to the lake and the fact that it is so far from the Hay Ranch wells. Additionally, maximum drawdown in the North Dock well would occur long after cessation of pumping at Hay Ranch. The amount of groundwater table drawdown seen at any point throughout the valley would depend mainly upon how close the point is to the Hay Ranch production wells. A 10% decrease in groundwater elevation at the north end of Little Lake would appear as a larger drawdown in groundwater levels in wells closer to Hay Ranch than in those farther from Hay Ranch. Monitoring must occur closer to Hay Ranch, in order to ensure that the lake never reaches more than 10% decrease in groundwater inflow.

The existing groundwater model predicts that, with a specific yield value of 10%, a maximum of 10% reduction in groundwater inflow to Little Lake (this is currently benchmarked to a drawdown of 0.3 feet in the Little Lake North Dock well) would occur following pumping at Hay Ranch at proposed pumping rates for a period of approximately 1.2 years. The model predicts that this maximum drawdown would occur as much as 30 years after the cessation of pumping at 1.2 years, due to the

large distance (9 miles) from the pumping. Other locations closer to Hay Ranch would likely record their maximum drawdown after much shorter periods of time, as shown in Table 3.2-7. For example, if pumping ceases at 1.2 years, at the Cal Pumice well, the model predicts that maximum drawdown (7.1 feet) would be reached at approximately 1.25 years, at Coso Ranch North Well a maximum drawdown of 2.5 feet would be reached at 3 years, and at the Red Hill Cinder Road Well, the maximum drawdown would be expected to be 0.7 feet at approximately 12 years.

Mitigation, therefore, allows initiation of pumping for the project at the proposed project pumping rate, until drawdown trigger levels are reached at one or more monitoring locations throughout the valley (Table 3.2-7). Model predictions indicate that the trigger levels could be reached in as little as 1.2 years; however, some conservative assumptions that are built into the model may extend this pumping period considerably longer, if actual decreases in the groundwater level occur more slowly than predicted. The trigger points have been established using the model to prevent a greater than 10% decrease in flows to Little Lake from ever occurring. Triggers are also further described in the HMMP in Appendix C4. Monitoring should occur monthly for at least three years, with results reported to the County within 2 weeks of data collection. After three years, if water levels are decreasing more slowly than predicted, the applicant can petition the County to reduce the measurement frequency to quarterly.

Data collection in the first few months to years would lead to a better understanding of the relationship between pumping at Hay Ranch and groundwater table drawdown throughout Rose Valley and at Little Lake. Pumping may continue as long as the project does not result in a significant decrease in groundwater available at Little Lake.

The types of data that would be collected to better understand and estimate sustained pumping rates after one year are fully described in the HMMP provided in Appendix C4. Within approximately 1 year of initiation of pumping, or less if trigger levels are reached sooner, the groundwater flow model should be recalibrated to the observed drawdown in groundwater levels, to allow for more accurate estimation of how long the pumping can continue without exceeding drawdown trigger levels and causing a significant reduction in water available to Little Lake, the springs, and wetlands. A qualified person approved by Inyo County Water Department and funded by the applicant would evaluate the results of the first year of data collection, would recalibrate the model, and working with the Inyo County Water Department and the applicant, and would estimate the duration of pumping that would keep impacts below the defined trigger levels. Recalibration of the model would also be necessary later, if pumping continues significantly longer than 1.2 years, as needed and appropriate to help understand the timing and magnitude of future drawdown of groundwater levels throughout the valley.

Implementation of mitigation measure Hydrology-3 along with Hydrology-4 would reduce potentially significant impacts to less than significant levels.

> **Hydrology-3:** Monitoring shall occur at a frequency that is sufficient to detect important changes and trends in water levels. Monitoring shall occur monthly, at a minimum, at all monitoring points, following project start-up. The data shall be collected and analyzed by a qualified person approved by Inyo County Water Department and provided by the applicant. Monitoring reports shall be prepared by the applicant and submitted to Inyo County Water Department within 20 days of data collection. After two years, monitoring shall occur quarterly. Reports shall also be provided to a designated recipient at Little Lake Ranch, Inc. A complete list of monitoring locations, parameters, and schedule is presented in Appendix C4, Tables C4-1 and C4-2. Hydrologic monitoring locations are shown on Figure C4-2, in Appendix C4. Two new monitoring well clusters, each with three wells with screened intervals at three different depths, located approximately 700 feet south of the Hay Ranch North Wells, and 700 feet south of the South Well, respectively, shall be installed by the project applicant, and as approved by the Inyo County Water Department. An additional new water table monitoring well shall be installed by the applicant and as approved by Inyo County Water Department,

Table 3.2-7: Drawdown Trigger Levels (in feet)

Project Elapsed Time, years	Dunmovin Area well	Pumice Mine well	Hay Ranch Observation well	Coso Ranch North well	Coso Junction #1 well	Navy G-36 well	Navy Lego well	Red Hill Cinder Road well	Navy 18-28 well	Little Lake Ranch North well
	Distance from Hay Ranch South Well (feet)									
	9,000	*6,100*	*1,300*	*9,700*	*10,900*	*26,000*	*27,300*	*32,000*	*38,000*	*42,600*
0.25	<0.2	0.5	3.1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
0.5	0.3	1.3	4.7	0.4	0.3	<0.2	<0.2	<0.2	<0.2	<0.2
0.75	0.7	3.3	8.1	0.9	0.7	<0.2	<0.2	0.2	<0.2	<0.2
1	1.1	5.3	11.5	1.4	1.2	<0.2	<0.2	0.2	<0.2	<0.2
1.2	1.5	6.9	13.2	1.8	1.5	0.2	0.2	0.3	<0.2	<0.2
1.25	1.6	7.1	11.8	1.9	1.6	0.2	0.2	0.3	<0.2	<0.2
1.5	1.9	7	7.9	2.1	1.8	0.2	0.2	0.3	<0.2	<0.2
1.75	2.1	6.5	6.9	2.3	2	0.3	0.3	0.3	<0.2	<0.2
2	2.3	6	6.2	2.4	2.1	0.3	0.3	0.4	<0.2	<0.2
3	2.7	4.8	4.8	2.5	2.2	0.5	0.4	0.4	<0.2	0.2
4	2.8	4.1	4	2.5	2.2	0.6	0.6	0.5	0.2	0.3
5	2.7	3.6	3.5	2.4	2.2	0.7	0.7	0.6	0.3	0.3
Maximum Acceptable Drawdown (in feet)	2.8	7.2	13	2.5	2.3	1.1	1.1	0.7	1	0.4
Time to Max drawdown (years since pumping began)	4	1.3	1.2	3	3.5	14.5	15	12	22	13

NOTES

1) For any wells where predicted drawdown is less than or equal to 0.25 feet, actions related to these trigger points shall not be enforced, unless the drawdown seen in these wells is greater than 0.25 feet. Drawdown values of <0.25 feet are difficult to accurately detect.

2) Based on current groundwater flow model results, these maximum drawdown values listed above result from pumping the Hay Ranch production wells at design rates for 1.2 years, with specific yield values of 10%. These maximum acceptable drawdowns can occur several years after pumping at Hay Ranch ceases.

approximately midway between Coso Junction and the Cinder Road Red Hill well, to provide additional monitoring capability in this area.

The monitoring program also includes reassessment of model-predicted impacts and recalibration of the groundwater model by a qualified person approved by the Inyo Count Water Department, and provided by the applicant. After a period of one year of pumping, observed groundwater level changes shall be compared with predicted groundwater level changes in order to assess the accuracy of the model-predicted drawdown. If the observed water level changes at two or more of the selected monitoring points differ from predicted values (trigger levels) at those locations by at least 0.25 feet at any point in time, or a maximum acceptable drawdown is reached at a designated monitoring point, or as judged appropriate by Inyo County Water Department, the model shall be re-calibrated and the predicted impacts to groundwater levels re-forecast with the re-calibrated model. If the model results change with recalibration, the mitigation strategy shall be updated in response to new forecasts of potential impacts to groundwater, potentially including reducing the duration or rate of pumping, or other mitigation measures as described in the HMMP. Additional re-calibration is expected to be needed after one year, as monitoring continues and water level changes are detected farther down Rose Valley. Additional re-calibration of the model shall be conducted as appropriate following the criteria outlined above (i.e., if the predicted water level

in two or more wells differs from observed water level drawdown by at least 0.25 feet or more, or one or more maximum acceptable drawdown levels in wells all across the valley are exceeded).

Because surface water bodies at the Little Lake Ranch property are likely sensitive to changes in groundwater elevation and groundwater flow rate, the monitoring plan also identifies trigger levels that indicate when a significant impact (defined as a substantial reduction in water to Little Lake) will likely occur unless mitigation measures are implemented to reduce the pumping rate and/or duration of pumping. The plan includes the implementation of mitigation measures (namely, Hydrology-2 and Hydrology-4) to reduce any potentially significant impacts to less than significant levels.

Hydrology-4: The applicant shall be allowed to pump the project at the full proposed pumping rate until a time when and if the predicted groundwater drawdown trigger levels are exceeded at two or more of the designated Rose Valley monitoring points by at least 0.25 feet, or if a maximum acceptable drawdown level is exceeded in any monitoring point.

During the first year, a qualified person, approved by Inyo County Water Department and provided by the applicant, shall conduct the studies described in Hydrology-1 and Appendix C4 of this EIR in order to recalibrate the groundwater model to the early groundwater data. The groundwater model shall be recalibrated in order to more accurately understand the relationship between groundwater pumping, reduction in groundwater elevations across the valley, and availability of water at Little Lake. Pumping rates and duration of pumping shall be determined based on the results of the model and the observed water table drawdown.. At no time shall projected results of pumping result in a greater than 10% decrease in groundwater inflow to Little Lake (estimated to be equivalent to a 0.3-foot drawdown in groundwater head at the northern end of Little Lake) unless new data collected in the vicinity of Little Lake indicates that a larger decrease of head would not result in a greater than 10% decrease in groundwater inflow to Little Lake or substantially deplete the water availability to the springs and wetlands (as defined in the Hydrologic Mitigation Monitoring Plan in Appendix C4 of this EIR).

The revised pumping rate and duration shall be approved by the Inyo County Water Department. The recalibration shall occur within one year after project startup to ensure adequate time is available to make adjustments to the pumping schedule if necessary, to ensure significant impacts do not occur. The model shall be calibrated to the new drawdown data collected since project startup. Based on the results of the recalibrated model, a revised schedule for pumping and revised trigger levels shall be determined that will not be expected to cause a greater than 10% decrease in groundwater inflow to Little Lake. A revised plan for pumping rate and/or duration of pumping shall be submitted with full documentation to the Inyo County Water Department by the end of the 1st year of pumping. Pumping can continue as long as trigger levels in designated monitoring points that prevent a significant impact are not exceeded, and other signs of substantial impact on surface water bodies (Little Lake, springs, and wetlands) are not observed, as determined by a qualified person approved by Inyo County Water Department provided by the applicant.

An alternative option to minimize impacts to Little Lake could include pumping for one or more years at full scale and model recalibration as prescribed above; however, then reducing pumping to a lesser degree and/or allowing pumping for a longer period of time along with implementing a groundwater diversion plan at Little Lake. The diversion system would include additional pumping from an existing well at the Little Lake Ranch property, if feasible, or construction of a new well. Water would be piped from the well location along existing unpaved roads to the lake where it would be discharged. Water would be withdrawn at the minimum rate necessary to sustain water availability to Little Lake and the lower pond areas. The pumping amount and duration for a water diversion at Little Lake would be determined by a qualified person approved by the Inyo Count Water Department, and provided by the applicant, based on the recalibrated model. The diversion plan is further described in Appendix C4. Diversion would only be effective and implementable to minimize effects to less than significant levels if it was:

- Feasible given the availability of water at Little Lake and would not result in impacts to existing springs (e.g., Coso Spring)

- Agreed upon with Little Lake Ranch and the applicant
- Funded by the applicant
- Required for a reasonable timeframe (i.e., 20 years) that ensured accountability and funding by the applicant to mitigate all effects

If any of the above criteria are not met, then pumping would be scaled back or terminated based on model recalibration as previously described. If determined feasible, the applicant shall use biological and archaeological monitors during all ground disturbance activities associated with the construction of the augmentation plan components. The applicant shall also be responsible for obtaining any required permits for the diversion plan at the time that it is designed and implemented.

Depending on the permeability of lake bed sediments (which is currently unknown), groundwater diversion on the property may slightly raise or lower the groundwater table beneath Little Lake. If more permeable sediments are present, more water will seep back into the aquifer through the lake bottom. If less permeable sediments are present, less groundwater will seep back into the aquifer beneath the lake and drawdown may increase over and above the drawdown created by Hay Ranch well operation. However, if less groundwater seeps back into the aquifer, less groundwater will need to be diverted to maintain the lake level. Flow diversion would not likely impair spring or siphon well flow because most of the groundwater would be returned to the aquifer or pond system by way of seepage from the lake bottom or infiltration losses from the outfall stream.

Diversion by pumping groundwater from one of the Little Lake Ranch wells into the lake reportedly has been conducted in the past; however, details of previous water diversion efforts were not available for review. The modeling indicated that pumping a well near the south end of the lake or farther south on the Little Lake Ranch property would minimize impacts on Little Lake. The currently unused Little Lake Hotel well was reportedly artesian indicating that it is completed below the groundwater table in a confined groundwater-bearing zone. Extraction from the Hotel well or from the depth interval screened by that well, south of Little Lake, would minimize impacts to the lake and shallow groundwater.

Use of a biological and archaeological monitor during construction of the augmentation plan would minimize potential impacts to biological and cultural resources. Use of a monitor would allow sensitive resources to be avoided. Impacts to biology and cultural resources would likely be less than significant due to the scale of the project (which would likely include a 20-foot long pipeline) and the fact that access and construction would occur in previously disturbed areas. The applicant would also arrange for the appropriate electrical upgrades, and fund the cost of supplying and maintaining the electrical power, well, and pump equipment, if needed, at Little Lake Ranch to support pumping. The timing of the implementation of the proposed temporary augmentation plan is defined and would be determined through implementation of the HMMP prescribed in mitigation measure Hydrology-1.

It should also be noted that the applicant is subject to all regulations as stated in the Inyo County Code, Chapter 18.77.045 and 18.77.055, which allows for the CUP to be challenged if at any time if conditions of the permit are not being implemented or pumping is proven to be “causing unreasonable effect on the overall economy or environment of Inyo County.” The permit could be modified or revoked as a result. Conditions of the code also help to minimize the potential for potentially significant impacts associate with the project. The final decision on any modifications to the CUP shall be in compliance with the Inyo County Code.

Decommissioning

Decommissioning would involve removing above ground project components, including the tanks and the equipment on the Hay Ranch property, and abandoning the underground pipeline in-place. Pumping of the Hay Ranch wells would terminate and no more water would be transported out of the basin as part of the proposed project.

Impacts to groundwater levels from decommissioning would cease; however, there is a time lag for drawdown caused by the previous operations of up to 30 years or more after pumping has ceased. Groundwater levels would begin rising back to predevelopment levels following the time lag. Groundwater levels are expected to continue to decrease for a period of time following cessation of project pumping, as previously described, in areas in the southern part of the valley. Mitigation measure Hydrology-4 requires monitoring during pumping to ensure that trigger levels for groundwater drawdown in all monitoring wells will not be exceeded even after pumping ceases. Impacts would be less than significant with implementation of this measure.

Potential Impact 3.2-3: The potential to cause a significant alteration in the temperature or water levels of the surface features at Coso Hot Springs through injection of additional water into the Coso geothermal reservoir

Overview of Impact

Construction of the proposed project would have no impact on the Coso Hot Springs. Project operation has the potential to impact the hot springs. The Coso Hot Springs have been monitored closely since the beginning of geothermal production in 1988. On-going numerical modeling has been performed to understand the relationship between changes in Coso Hot Springs and geothermal development. Observed variations in hot springs may or may not be a result of the existing geothermal operations, although strong evidence supports a relationship where reduced pressure in the geothermal field creates an increase in the size of the steam cap. This increased steam cap is believed to have influenced the hot springs, making them initially increase in water level and temperature right after geothermal activity commenced in the late 1980s. The proposed project involves injecting water into the system, which theoretically could counter the pressure differential and result in a decrease or stabilization of the steam-dominated portion of the reservoir and a decrease (or stabilization) in water level and temperature in the hot springs. These changes could make the hot springs closer to their pre-geothermal development condition.

The geothermal system is highly complex and also influenced by many natural factors. Negative changes to the hot springs are not expected as a result of the proposed project. The monitoring program established at the beginning of the development of the Coso geothermal resource and specified in the original 1979 MOA between CLNAWS, the State Historic Preservation Officer, and the Advisory Council on Historic Preservation records physical changes in the Hot Springs. This existing, ongoing monitoring program provides a safeguard for the Hot Springs by providing a long history of the physical conditions at the Hot Springs before the project and a record of the physical conditions through the life of the project.

Construction

Construction would have no hydrologic impacts on the Coso Hot Springs. Construction would occur on the surface, 2.5 miles from the Coso Hot Springs and would not involve the geothermal reservoir or result in impacts to the reservoir.

Operation and Maintenance

Project operation includes injection of groundwater into the existing geothermal field in the Coso range at a rate of approximately 4,839 acre-ft/yr (or 3,000 gpm of water or 1,500 kph) into the reservoir. The water would be added to the existing injection system, which is designed to distribute the water at multiple locations within the reservoir in order to maximize the production from the injection and minimize cooling or ponding of injected water. Evaluation of the effectiveness of the injection program would continue throughout the project and adjustments would be made as additional information is gathered.

Injection may or may not have an impact on the nearby Coso Hot Springs. The hot springs are made up of a series of pools located 2.5 miles from the proposed injection site. The hot springs are believed to be created by brine and steam that condenses at it reaches the surface, which travels along the Coso Wash Fault. The springs are a site of Native American interest and included in the National Register of Historic Places (refer to Section 3.5 Cultural Resource). Concerns regarding the potential effects of the project on the Coso Hot Springs include potential changes to the temperature, water levels or appearance of the Coso Hot Springs, and related surface manifestations of the Coso geothermal system as a result of the proposed injection into the geothermal reservoir.

The Coso Hot Springs have been monitored continuously since geothermal production began in 1988. The monitoring results suggest that water temperatures and average water levels in Coso Hot Springs South Pool have increased over time. South Pool water levels stabilized rapidly; however, temperatures increased until 1993, then decreased in 2002 (Figure 3.2-18, Geologica 2007).

Elsewhere in the Coso Hot Springs area, steam manifestations have both increased (Pipeline and Fault Line fumaroles) and decreased (Devil's Kitchen). Water levels in wells east of the hot springs have decreased in area, but remained steady after the initial change (Coso #1), while wells west of the Coso Hot Springs (4P and 37-4TCH) have increased in area following the initial change. Many of the changes since the onset of geothermal reservoir production have been abrupt and erratic, whereas reservoir production has been relatively steady. Changes in chemistry of the monitored surface manifestations are variable, but generally reflect a decrease in brine component of the water making up the surface manifestation relative to the steam or steam condensate component.

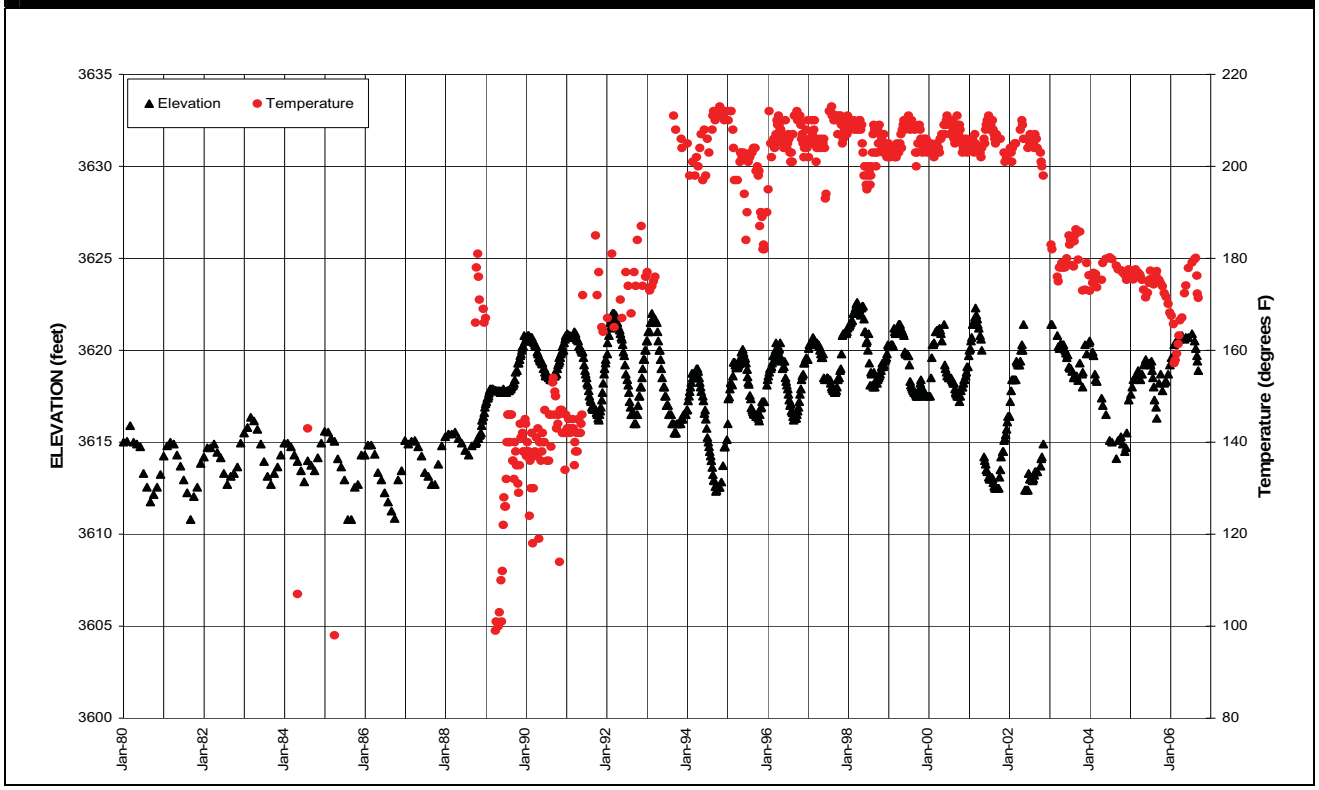
Steam flows in wells, water levels in wells, and surface manifestations reflect seasonal (and sometimes diurnal) variations (Geologica 2007). Changes to surface manifestations do not appear to correlate temporally with available injection data. Nor do they correlate with changes in rainfall or seismic events (Geologica 2005; 2006; 2007).

Innovative Technical Solutions, Inc. (ITSI) prepared an independent analysis of the hot springs in April 2007 for the Geothermal Program Office of the US Navy. The purpose of the study was to investigate and model a possible connection between geothermal production and changes observed at the Coso Hot Springs since 1988. The report prepared by ITSI in 2007 suggests that there is a correlation between the increase in the steam zone within the reservoir and increased steam flow up the Coso Wash Fault. Increases in temperatures and water levels in the South Pool are related to increased steam discharge based on numerical simulation. Changes in chemistry (Geologica 2005; 2006; 2007), and stable isotopes (Adams 2004) also suggest increased geothermal reservoir steam discharge at the surface.

There has been extensive study of the relationship of the Coso Hot Springs to the geothermal reservoir and local groundwater, particularly studies initiated by the Navy (including Erskine and Lofgren 1989, Guler, 2002, Williams, 2004 and ITSI 2007). Most studies indicate that there is no dilute low-temperature groundwater overlying the reservoir (Adams et al. 2000). Although there is some evidence of geothermal discharge to groundwater systems south to Indian Wells Valley and west towards Rose valley (Williams 2004), the relationship of the developed portion of the geothermal system to surrounding groundwater appears to be limited by no-flow boundaries such as the Coso Wash Fault and a mineralogical cap (ITSI 2007).

Stable isotopic signatures of Coso Geothermal fluids have been evaluated for purposes of identifying the source of the geothermal fluids (Figure 3.2-19). The High Sierras (Fournier and Thompson 1980) and the Coso Range (Williams and McKibben 1990) have been identified. Isotopic signatures of fluid samples from the surface studies also suggest that waters from the surface manifestations are affected by boiling or have a slightly different source.

Figure 3.2-18: Temperature and Water Level Variations in South Pool Geothermal Production began in October 1987



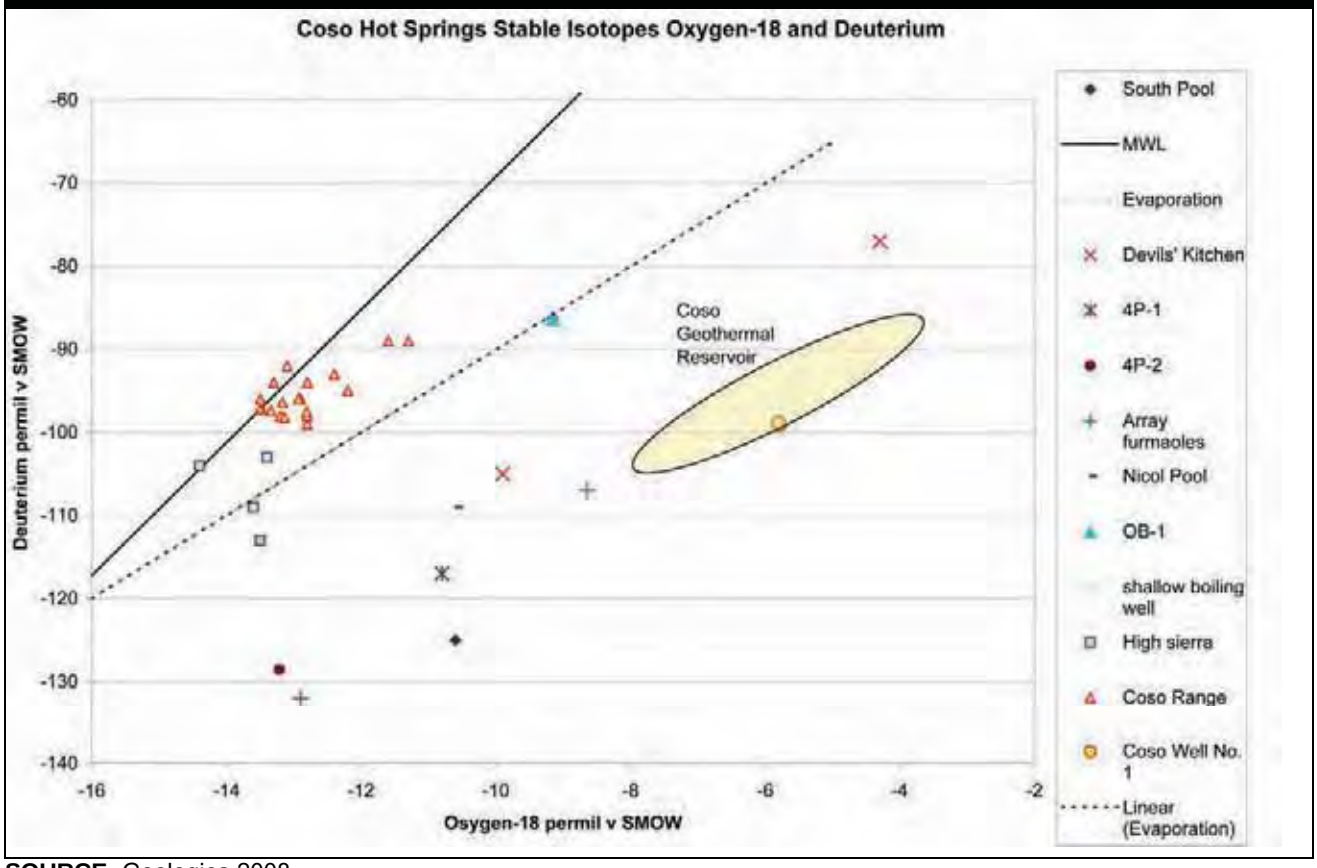
SOURCE: Geologica 2008

A steam zone is believed to have developed in the reservoir as a result of pressure decline related to a net mass deficit from the geothermal reservoir (ITSI 2007). The proposed project would reduce the net mass deficit by approximately 1,500 kph from 50 percent to less than 20 percent, thereby slowing or reducing this change. Projected overall reservoir behavior based on reservoir modeling by Coso (personal communication 2008) indicates that production declines would slow, suggesting pressure support, and enthalpy would stabilize or decrease, suggesting the impact of injection related to the proposed project on the geothermal reservoir is most likely to reduce the growth of the steam zone within the reservoir.

Although changes in surface manifestations described above correlate temporally with the onset of geothermal development, the direct relationship between development of the resource at Coso and the variation in the physio-chemical character of the Coso Hot Springs such as South Pool is less clear. ITSI (2007) suggests that the development of the steam zone has produced increase steam discharge along the Coso Wash Fault and the rise in water levels and temperatures in South Pool are related to increased steam discharge to the surface. This correlation is not unreasonable and has been suggested for correlations between changes in surface manifestations and development of other geothermal fields (Sorey 2000). However, the changes in South Pool have occurred in abrupt steps with some reversals (see Figure 3.2-3b) and the growth of the vapor zone in the reservoir has been more gradual than changes in South Pool.

Geothermal development may or may not have produced observed changes to the Coso Hot Springs. If the observed changes at Coso Hot Springs are related to an increasing steam zone within the reservoir related to geothermal development, the proposed project would likely reduce or reverse those changes by reducing the development of the steam zone.

Figure 3.2-19: Coso Hot Springs Stable Isotopes Oxygen-18 and Deuterium



SOURCE: Geologica 2008

Impacts to the surface manifestations of the Coso geothermal system related to the project would be minimal because:

1) Connection to the reservoir appears to be indirect
2) The proposed project would increase liquid injection and decrease the net withdrawal related to geothermal development thereby minimizing the pressure decrease-related development (or possibly reversing) of a vapor-dominated zone within the reservoir. By minimizing changes in the reservoir from the existing geothermal project, changes to the surface manifestations that may be connected to the reservoir would be minimized

Therefore, depending on the level of connection, this project will act to minimize additional changes because the goal of the project is to support reservoir pressure and therefore the project is unlikely to create changes in surface manifestations.

Potential impacts to the hot springs from the original Coso Geothermal Power Development fall under the existing 1979 MOA between CLNAWS, the SHPO, and the Advisory Council on Historic Preservation (refer to Appendix E). This MOA addresses development of geothermal resources on Navy fee-acquired land within the Coso known geothermal resource area (KGRA). The proposed project is part of the development of the Coso KGRA; therefore, it falls under this MOA. The MOA Includes consultation and although this project is not expected to have a significant impact on Coso Hot Springs, the existing monitoring program provides both a long baseline of physical conditions as well as monitoring over the life of the project. This existing monitoring program includes acquisition of appropriate data to monitor changes to the Hot Springs over the life of the project presenting additional safeguard for the Hot Springs and an agreement for handling any changes to the hot

springs. With implementation of measures in the MOA, the project is not expected to have a significant impact on Coso Hot Springs. No mitigation for the proposed project is needed. The 1979 MOA is included in Appendix E to this EIR.

Decommissioning

Decommissioning would involve removal of project equipment on public land and abandonment of the pipeline in place. Equipment on the Hay Ranch property would be removed and disposed of, stored, or recycled. Injection would cease just prior to the decommissioning phase. Some changes may occur to Coso Hot Springs after project decommissioning; however, changes would be a result of restoration of natural conditions and would therefore not be significant. Decommissioning would have less than significant impacts on the Coso Hot Springs.

Potential Impact 3.2-4: The potential to substantially alter the existing drainage pattern in the project area in a manner which would result in substantial erosion or siltation on- or off-site

Overview of Impacts

Grading, foundation work, installation of drainage structures, and surface activities would result in temporary disturbance of approximately 59.5 acres of native vegetation and soils, and could result soil erosion and siltation of on and off-site drainages. These potential erosional impacts would be mitigated to less than significant levels through implementation of a SWPPP and implementation of an erosion control plan. Impacts would be less than significant. Project operation would have less than significant impacts on existing drainages and erosion or siltation. Some water discharge may be performed for pipeline maintenance, but it would be minimal and would not cause substantial siltation of existing waterways.

Construction

Wells. Wells would require the installation of down hole pumps and equipment and would have no potential to substantially alter existing drainage patterns on the project site that could result in erosion or siltation. Installation of the down hole pumps would not require any ground disturbance.

Lift Pump Station, Substation and Associated Facilities, and Tanks. Construction of these components would require about 6 acres of ground disturbance. With the exception of the 1.5 million gallon high point tank, all other facilities would be constructed on the Hay Ranch property. Drainage on the Hay Ranch property is to the south due to the gentle slope of the property in that direction. Construction would not change the existing drainage pattern such that substantial erosion or siltation would occur off-site.

Any exposed soils remaining after the construction of the station would be revegetated in accordance with COC's approved revegetation plan to minimize soil erosion. The lift pump station area would be finish-graded to provide for drainage to the southeast (the direction of natural slope on the parcel). A SWPPP would be implemented for the entire project as required by law to avoid erosion impacts due to drainage. Implementation of the mitigation measure Geology-1, which requires an erosion control plan would also reduce potential impacts to less than significant levels.

Pipeline. Construction of the pipeline route would require approximately 53.5 acres of ground disturbance. Grading would be minimized, particularly in the steeper areas near the high point tank, by constructing the right-of-way perpendicular to the contours. At the completion of pipeline construction, the right-of-way would be restored by finish grading with installation of water bars, and application of erosion protection in accordance with COC's approved revegetation plan to minimize effects to drainage. All fill slopes would receive erosion protection by redistribution of topsoil and

application of a standard desert seed mixture at a rate of 25 pounds per acre. There are no perennial drainages in the vicinity of the pipeline route.

Operation and Maintenance

Wells, Lift Pump Station, Substation and Associated Facilities, and Tanks. These facilities would not alter drainage in the project area that could lead to substantial siltation off-site. These facilities would add about 3 acres of impervious surface. Water runoff would follow natural drainage patterns and would not result in substantial erosion of soil. The high point tank includes an overflow drain, which would be directed to an existing drainage. Soil erosion may occur at this point, depending on the quantity of water that could be released from the tank. To minimize soil erosion at either tank from periodic water releases, mitigation measure Geology-2 would be implemented, which requires stabilizing tank outlets with rip rap to minimize soil loss and sedimentation.

The tanks have sensors and alarm systems that are manned at the power plant 24 hours per day to minimize overflow and to identify emergency situations or failures. Catastrophic failure of either tank could cause soil erosion, particularly at the high point tank, which is larger and located on a hill. The potential for catastrophic failure is low and the impact is considered less than significant.

Pipeline. Maintenance of the pipeline may require some small discharges of water from air release valves along the pipeline. Erosion and sedimentation could occur from drainage of the pipeline for maintenance. These discharges would be small quantities (tens of gallons) of water directed towards the natural drainage adjacent to the road. If maintenance requires excavating portions of the pipeline, mitigation measure Geology-1 would be implemented to minimize erosion to less than significant levels.

Decommissioning

Decommissioning would involve removing or abandoning equipment in place. Minimal soil disturbance would be involved with the project decommissioning to remove foundations. The ground would be revegetated according to COC's approved revegetation plan. Mitigation measure Geology-1 would also be implemented. The proposed buried pipeline would be abandoned in place. Impacts would be less than significant with the appropriate measures.

Potential Impact 3.2-5: The potential to cause substantial flooding that could result in damage to life or property

Overview of Impacts

The proposed project would not cause flooding from construction, nor would operation result in a significant potential to cause or be damaged by floods. Impacts related to flooding and flooding hazards are less than significant.

Construction

Construction would not cause substantial flooding. Some water would be used for dust suppression; however only small quantities would be applied to disturbed surfaces. Flooding would not occur.

Operation

Haiwee Creek runs south along the east side of US Highway 395, portions of which are identified as a Zone A Flood Zone. None of the structures of the proposed project are within the 100-year flood hazard area as mapped on the federal Flood Hazard Boundary Map or the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map No. 060073 1925B, dated September 4, 1985. If the creek flooded greater than the 100-year event as mapped by the FEMA projections, portions of the Hay Ranch property could experience minor flooding. The probability of this

magnitude storm event occurring is so remote as to be less than significant. There are no inhabited structures or residences on the Hay Ranch site, nor along the 9 mile pipeline route.

The Hay Ranch wells are at elevation 3,437 feet amsl and the south spillway of Haiwee Reservoir is at an elevation of 3,760 feet amsl. The reservoir holds approximately 28,000 acre-feet of water. The dam is located approximately 4 miles north of the Hay Ranch property and the terrain from the dam to Hay Ranch is a relatively broad, open plain. If the dam suffered catastrophic failure, floodwaters would inundate the substation and nearby pipeline corridor, and damage structures as far away as Coso Junction. Therefore, the substation and portions of the pipeline corridor could suffer major flood damage. The substation would immediately become inoperable and pose no threat to workers or nearby residences or businesses. No element of the proposed project would lead to increased probability of a catastrophic failure of Haiwee Dam, and, the probability of a catastrophic failure is so remote as to be considered less than significant.

The project includes two water storage tanks, one holding 150,000 gallons and the other holding 1,000,000 gallons. Failure of these tanks would cause localized ponding on the Hay Ranch property and in the region of the high point tank. The tanks are designed to prevent catastrophic failure, including equipment that detects water level and leaks. The likelihood of catastrophic failure of the tanks is so remote that it is considered less than significant. Leakage of the pipeline could also cause some localized flooding; however, equipment would monitor pressures in the pipeline and regular inspection and maintenance would minimize the chances of pipeline failure that could result in localized flooding.

Decommissioning

Decommissioning would involve removal of project equipment on public land and abandonment of the pipeline in place. Decommissioning would minimize the potential for localized flooding since the project would no longer pump, store, or deliver water. There would be no flooding related impacts from project decommissioning.

Potential Impact 3.2-6: The potential to cause a violation of water quality requirements or otherwise degrade existing water quality in the area or impact drinking water and drinking water supplies

Overview of Impacts

Substantial withdrawals of water could potentially cause changes in groundwater flowpaths, such that the source of water at a particular well could be from a different area with a different water quality. However, given the scale of the area, it appears unlikely that changes in groundwater flow paths will be far-ranging enough to cause significant changes in the quality of groundwater. No significant impacts to surface water or groundwater quality are expected during construction or as a result of operation of the project.

Construction

Construction is not anticipated to have any impact to groundwater or surface water quality. The groundwater table is located more than 200 feet below ground surface along the pipeline alignment; spills or releases from construction equipment are unlikely to migrate down to the water table in sufficient volume as to impact groundwater quality. No perennial surface water bodies are located within or down gradient of the construction and therefore there impacts to surface water quality from construction are unlikely.

Operation and Maintenance

Operation of the proposed project is unlikely to have any significant impact on groundwater or surface water quality. The groundwater extracted by the Hay Ranch wells would primarily come from drainage of saturated soil pore space in the recent alluvial sediment deposits near the wells and to a lesser extent, groundwater inflow from Owens Valley and mountain front precipitation recharge in the Sierra Nevada range.

Groundwater flowing towards Little Lake Gap, currently, and after project startup, primarily comes from mountain front precipitation recharge entering the basin at locations downgradient (south) of the Hay Ranch with a smaller component of groundwater flowing downgradient (southward) within the valley aquifer. The mountain front recharge has good water quality (total dissolved solids <500 mg/L, see section 3.2.3. The valley aquifer water is higher in dissolved solids relative to mountain front recharge (total dissolved solids > 500 mg/L). Operation of the Hay Ranch project would have no effect on the chemical character of Sierra Nevada mountain front recharge; consequently, the project is unlikely to impact the quality of groundwater flowing towards Little Lake Gap and as seen in the surface manifestions (i.e., springs, siphon wells, Little Lake, and surrounding ponds and wetlands).

If the inflow to the southern part of Rose Valley from groundwater flowing downgradient within the valley aquifer is reduced, it is possible that the dissolved solids of groundwater flowing southward towards Little Lake Gap may be slightly reduced. By reducing the component of inflow of saline valley basin water relative to dilute mountain recharge water, the dissolved solids of groundwater in the Little Lake area may decrease, improving water quality. Effects to water dependent vegetation are addressed in Section 3.4 Biological Resources.

Decommissioning

Decommissioning would involve removal of project equipment on public land and abandonment of the pipeline in place. Decommissioning would not impact water quality since it would result in the restoration of natural conditions in the aquifer. The groundwater table is located more than 200 feet below ground surface along the pipeline alignment; spills or releases from demolition equipment are unlikely to migrate down to the water table in sufficient volume as to impact groundwater quality.

APPENDIX C

PUMP TEST RESULTS AND HYDROLOGIC DATA

APPENDIX C1
NOVEMBER/DECEMBER 2007 PUMPING TEST PROCEDURES, MONITORING DATA AND RESULTS

APPENDIX C1
NOVEMBER/DECEMBER 2007 PUMPING TEST PROCEDURES, MONITORING DATA, AND RESULTS

C1-1 Introduction

This appendix describes the procedures employed, equipment used, and monitoring results from a constant discharge aquifer pumping test conducted in Rose Valley, California in November and December 2007. The 14-day constant discharge aquifer test was conducted to further evaluate the potential impacts of extracting groundwater from the Hay Ranch property in north central Rose Valley for use in augmenting water supplies for the Coso Geothermal Project. Specifically, Coso Operating Company (COC) conducted an aquifer test to refine estimates of aquifer parameters (transmissivity, storage coefficient/specific yield, and vertical hydraulic conductivity or leakage) using transient data.

C1-2 Responsibilities

During the pumping test, COC's staff geologist and operations personnel were responsible for most field data gathering activities including installing electronic pressure transducers in selected wells, downloading electronic data on a daily basis for transmittal to Geologica , manually measuring water levels in observation wells, measuring the flow rate from the Davis well at Portuguese Bench, and recording the groundwater discharge rate from the pumped well. As a quality assurance measure, Geologica 's senior geologist/hydrogeologist visited the site at the start of the test on November 19, midway through the test on November 28, and on the last day of pumping on December 3, 2007 to observe test procedures. Geologica reviewed the pumping test data on a daily basis and recommended extending the test from the original planned 10-day constant rate pumping test to the final 14-day duration. COC engaged Howard Pump to place the test pump in the Hay Ranch South well and fuel the generator and maintain the equipment throughout the test. At the end of the test, Geologica analyzed the pumping test data to estimate aquifer parameters and to recalibrate a numerical groundwater flow model for Rose Valley (described in Appendix C-2 to this report).

C1-3 Aquifer Test Design and Procedures

The constant discharge pumping test comprised pumping the Hay Ranch South well for 14 days (from 3:59 p.m. on November 19 to 4 p.m. on December 3) followed by recovery monitoring for a period of approximately 7 days. The Hay Ranch South well was pumped at a constant rate of 1,925 gallons per minute (gpm) during the test. Background groundwater level and barometric pressure monitoring was initiated prior to the start of pumping in the Hay Ranch well to evaluate baseline conditions. The Davis's and COC staff measured the groundwater discharge rate from the Davis siphon well (aka the Davis spring) at Portuguese Bench using a bucket and stop watch periodically after the start of the pumping test. Pump test procedures generally followed the recommendations in the memo prepared by Geologica dated November 7, 2007 and are described below. Monitoring locations are shown on **Figure C1-1**.

C1-3.1 Test Well Setup and Monitoring

C1-3.1.1 Test Well Construction

The Hay Ranch South well is a former irrigation well constructed in 1974. The well was completed to a depth of 675 ft below ground surface (bgs). The 16-inch-diameter steel well casing has mill cut slots between 200 and 675 ft bgs but was gravel packed between ground surface and 675 ft bgs so is presumed to fully penetrate the Rose Valley alluvial aquifer. The South well reportedly has not been used since alfafa farming ceased, prior to COC's acquisition of the property. At the start of the pumping test on November 19, 2007, the depth to the groundwater table in the South well was 179 ft bgs.

C1-3.1.2 Test Pump

COC contracted with Howard Pump to install a temporary pump in the Hay Ranch South Well. Installation of the pump began the morning of November 19, 2007. The pump was set with the inlet bowls at a depth of 400 ft bgs. The line-shaft turbine pump was powered by a trailer mounted diesel engine with variable speed control. At the time of pump installation, a 100 pounds per square inch (psi) vented In Situ Mini-Troll electronic pressure transducer ("transducer") was installed approximately 145 ft below the initial groundwater table.

C1-3.1.3 Produced Water Discharge

Groundwater produced during the test was piped to an irrigation distribution system and discharged on the ground approximately ¼ mile south of the test well. A perforated pipe sprinkler system was used to distribute the water over the ground surface to reduce the potential for runoff, ponding, and/or soil erosion.

C1-3.1.4 Test Well Monitoring

COC initiated groundwater level monitoring in the test well using the In Situ data logging system at 12 noon on November 19, 2007. Water pressure, reflecting the height of the column of groundwater above the transducer, and water temperature were measured and recorded every 5 minutes until just before noon on December 6. COC staff made manual depth to water measurements in the well on November 15 and 19, 2007 using an electronic water level sounder. The pump contractor installed a flow meter/totalizer on the pump discharge line at the well head. COC operating department staff inspected the pump, generator, and discharge system four times each day (approximately every six hours) during the pumping portion of the test, and recorded flow rate and the flow totalizer reading in an operating log. A copy of the test well operating log is provided in **Table C1-1**.

C1-3.2 Observation Well Selection and Monitoring

The groundwater level monitoring program consisted of a combination of long term and short term monitoring conducted before, during, and after the pumping test depending on well access and operational constraints. COC utilized existing agriculture and drinking water supply wells owned by various parties including COC for pumping test monitoring; no new wells were constructed for this test. Most, but not all, of the wells monitored for

the 2007 pumping test are currently out of service. In addition to intensive monitoring of the North well on the Hay Ranch property, which is located approximately ½ mile north of the test well, wells were selected throughout Rose Valley to maximize the data set available for analysis. **Table C1-2** summarizes the wells monitored, duration and frequency, and monitoring equipment utilized. Well locations are shown on **Figure C1-1**.

Monitored well characteristics are briefly summarized as follows:

- The Hay Ranch North well was drilled in 1971 and is 724 ft deep with slotted screen open from 120 ft bgs to the bottom of the hole. Due to its depth, it is believed to fully penetrate the Rose Valley alluvial aquifer. Reportedly, the well has not been used since the mid-1970's. COC installed a 30 psi unvented transducer and initiated a groundwater level monitoring program in the well on August 29, 2007 and made manual water level measurements periodically during the pumping test. COC installed a 5 psi vented transducer in the well on November 19, 2007 and began automatic water level monitoring every 15 minutes with the more sensitive transducer at noon that day continuing through December 10, 2007.
- The out of service Cal-Pumice (Pumice Mine) well located approximately 1-1/4 miles northwest of the test well, is 397 ft deep with casing perforations between 300 and 397 ft bgs. The Pumice Mine well penetrates the upper portion of the Rose Valley alluvial aquifer. COC installed a 5 psi vented transducer in the well and began monitoring water levels every 15 minutes beginning on November 14, 2007 continuing through December 10, 2007.
- COC monitored groundwater levels in two former irrigation wells, V816 and V817, owned by the Los Angeles Department of Water and Power (LADWP) located approximately 1.7 miles north of the test well. The wells are approximately 500 ft deep and open to the upper portion of the Rose Valley alluvial aquifer. COC installed a 5 psi vented transducer in well V816 on November 14, 2007 and manually measured depth to groundwater in both wells periodically between November 14 and December 5, 2007.
- COC monitored groundwater levels in the Coso Ranch North well located on the west side of highway 395 approximately 1.8 miles south of the test well. No well log was available for the well. Because it appears to have similar construction to the Coso Ranch South well which is 740 ft deep, it is assumed to fully penetrate the Rose Valley aquifer. The Coso Ranch North well is not used, however, the Coso Ranch South well is pumped several times a day to fill a water truck for the Pumice mine. The Coso Ranch South well is located approximately 1,900 ft south of the North well; however, pumping the South well did not appear to measurably affect groundwater levels in the North well. COC installed a 30 psi unvented transducer and initiated a groundwater level monitoring program in the well on August 29, 2007 and made manual water level measurements periodically during the pumping test. COC installed a 5 psi vented transducer in the well on November 14, 2007 and began automatic water level monitoring every 15 minutes with the more sensitive transducer at noon that day continuing through December 10, 2007.

- COC manually measured depth to groundwater in two unused wells, the Lego well and well G-36, located on Navy property approximately 5 miles southeast of the test well. Although the wells are believed to be less than 400 ft deep, no construction details were available for either well.
- COC monitored groundwater levels in the Navy 18-28 well located approximately 7.2 miles southeast of the test well. The 430 ft deep well screens interbedded deposits of sand, basalt, and volcanic ash/tuff in the upper portion of the Rose Valley aquifer. COC installed a 30 psi unvented transducer and initiated a groundwater level monitoring program in the well on October 12, 2007 and made manual water level measurements periodically during the pumping test. COC installed a 5 psi vented transducer in the well on November 14, 2007 and began automatic water level monitoring continuing through December 10, 2007.
- COC monitored the groundwater level in an unused well (Little Lake Ranch North well) located at the north end of the Little Lake Ranch property approximately 8 miles south of the test well. No construction information was available for this well. Judging from the shallow depth to groundwater at this location, approximately 40 ft, the well is screened in the top of the Rose Valley alluvial aquifer. COC installed a vented 30 psi transducer and began monitoring groundwater levels every 15 minutes beginning on November 19, 2007 continuing through December 10, 2007.

All wells with pressure transducers were also manually gauged. Manual water level measurement data are summarized in **Table C1-3**. Because unvented pressure transducers were used in the long term monitoring wells, barometric pressure was monitored using an In Situ BaroTroll pressure transducer.

C1-3.3 Davis Siphon Well Monitoring

The groundwater discharge rate from the Davis family siphon well at Portuguese Bench was monitored periodically during and after the pumping test. The siphon well is located approximately 100 ft behind the Davis's house and uphill from their pond. The siphon well consists of an approximately 10 ft deep dug well vault with a slotted casing extending an additional 10 ft bgs (approximately 20 ft total depth). A sealed 4-inch-diameter PVC pipe inserted below the water level in the slotted casing crosses the property from the siphon well to discharge at the pond on the east side of the house. The discharge end of the pipe is lower than the groundwater level in the siphon well so that when the pipe is primed (filled with water) it freely siphons water from the well to discharge in the pond. To assess whether pumping the Hay Ranch wells might impact well discharge on the Davis property, the discharge rate from the siphon was measured approximately daily between November 19 and December 10, 2007. The groundwater disharge rate was measured using a stop watch to measure the amount of time required to fill a plastic bucket from siphon line to the pond. Measurements were repeated 3 to 5 times at each daily reading and recorded in a field notebook. A summary of the discharge readings is provided in **Table C1-4**.

C1-3.4 Interferences and Data Corrections

Several factors or events complicated analysis of the pumping test monitoring data. These included:

- The Hay Ranch South Well was pumped for approximately 10 minutes beginning at 3:25 p.m. on November 19 but the pump shut down due to a voltage regulation issue. The problem was fixed and the pumping test restarted at 3:59 p.m. Because of the short duration and great distance to observation wells, this pumping and recovery incident did not appear to induce response in observations wells. The test well recovered to within 2 ft of the initial static level by the time the 14 day test was started.
- Pre-existing water level trends, notably falling groundwater levels were observed in the Cal-Pumice, LADWP V816, and V817 wells. Data from the Cal-Pumice, V816 and V817 wells could not be used for aquifer parameter evaluation because of the nearly 0.4 ft drop in groundwater elevation observed in these wells between November 14 and December 5, 2007. The cause of the groundwater elevation decline in these wells is unknown. Data obtained from the LADWP aqueduct operations website indicated that the water level in the Haiwee South reservoir located nearly 2.5 miles north of the V816 and V817 wells, rose nearly 4 feet during this time period. Water seepage from the reservoir is believed to recharge the Rose Valley alluvial aquifer north of the Hay Ranch property and would be expected to increase or remain the same as reservoir levels rise. Consequently, it does not appear that changes in groundwater level in the LADWP wells were directly related to reservoir seepage.
- Water level drawdown was observed in the Coso Junction Store Well #1 resulting from unmetered pumping of the Coso Junction Store Well #2 which is approximately 25 ft south of well #1. This included a period of approximately 10 hours when the #2 well pumped without stop because of a water main break near the well head. As a result, the Coso Junction Store Well #1 groundwater level observations could not be used for aquifer parameter estimation.
- Uncontrolled pumping of the Coso Junction #2 well may have caused as much as 0.1 ft of groundwater level drawdown in the Coso Ranch North well, which is the next closest nearby observation well. The Coso Ranch North well appeared to have recovered from this disturbance at about the time it started to respond to pumping in the Hay Ranch South well.
- Groundwater elevation fluctuations throughout the Rose Valley monitoring well network as a result of variations in barometric pressure. Barometric pressure fluctuated over a range of up to 0.43 pounds per square inch (psi) [equivalent to 1 foot of water] between November 19 and December 4 (see **Figure C1-2**). This induced groundwater elevation fluctuations that ranged in magnitude from 0.05 ft in the Little Lake Ranch North well to 0.83 ft in the Hay Ranch wells. Increasing barometric pressure can induce an increase in apparent depth to groundwater in observation wells (and conversely) but has no significant affect on groundwater levels within the aquifer. When possible, barometric pressure fluctuations were correlated with groundwater elevation fluctuations to estimate barometric correction efficiency factors for individual wells. A barometric correction was applied to the transducer data that involved adding the negative of the product of barometric efficiency and barometric pressure change between water level readings to the recorded water pressure change. Estimated barometric efficiencies

ranged from approximately 5% in the Little Lake Ranch North well to 83% in the Hay Ranch wells. The barometric correction could not be applied to wells that were only gauged manually (V817, G-36, or Lego) because there were insufficient water level data to develop a correlation. The barometric correction factors were not effective in removing all apparent barometric-related water level fluctuations apparently due to variations in the response to barometric pressure fluctuations.

C1-4 Pumping Test Results

This section discusses the results of the constant discharge aquifer test.

C1-4.1 Pumped Well Response

The Hay Ranch South well drew down approximately 107 ft from static during the pumping test indicating a specific well capacity of 18 gpm/ft of drawdown. This compares well with the value of 21 gpm/ft noted for the 24 hour pumping test conducted in this well in 2003 (GeoTrans, 2003). The well recovered to within 3 ft of the initial static level within 3 days of terminating pumping. A plot showing groundwater elevation versus time in the pumped well is shown on **Figure C1-3**.

C1-4.2 Observation Well Response

Groundwater elevation measured in the observation wells is graphically depicted on **Figure C1-4** for the LADWP wells, **Figure C1-5** for the Cal-Pumice well, **Figure C1-6** for the Hay Ranch North well, **Figure C1-7** for the Coso Ranch North well, **Figure C1-8** for the Coso Junction Store #1 well, **Figure C1-9** for the Lego and G-36 wells, **Figure C1-10** for well 18-28, and **Figure C1-11** for the Little Lake Ranch North well. Manual gauging data are depicted as discrete points on the water level plots; transducer data are represented with a continuous line.

As noted previously, groundwater elevation in the LADWP wells (V816 and V817) and Cal-Pumice well declined nearly 0.4 ft between November 14 and December 10, 2007 (**Figures C1-4** and **C1-5**). Because they are located 9,000 and 6,400 ft north of the test well, respectively (see **Figure C1-1**), and because the water level decline started before pumping started, it was not possible to determine whether pumping the Hay Ranch South well caused drawdown in these observation wells. Evaluation of groundwater elevation changes in the Cal-pumice well was additionally complicated by water level fluctuations in the well apparently caused by barometric pressure fluctuations that were of the same order of magnitude as drawdown at this location potentially caused by test well pumping.

The groundwater elevation in the Coso Ranch North and Hay Ranch North wells appeared to decline approximately 0.3 ft and 6 ft, respectively, as a result of test well pumping. Evaluation of this response to estimate aquifer parameters is discussed below.

The groundwater elevation in the G-36 well which is located approximately 5 miles southeast of the test well declined slightly (less than 0.05 ft) during the pumping test but did not recovery after pumping stopped (**Figure C1-9**). The water level in the Lego well

(also located approximately 5 miles southeast of the test well) may have declined slightly but responded strongly to barometric pressure fluctuations, fluctuating nearly 0.3 ft as a result. Based on these observations, it appears unlikely that the test well pumping induced significant drawdown at this distance.

The groundwater elevation recorded in the Navy 18-28 well (**Figure C1-10**) increased by approximately 0.1 ft during the pumping test indicating no impact from pumping the Hay Ranch test well at this distance (more than 7 miles from the Hay Ranch). The groundwater elevation in the Little Lake Ranch North well (**Figure C1-11**) also increased very slightly (approximately 0.07 ft) during the pumping test indicating no response at this distance (8 miles south of Hay Ranch).

C1-4.3 Portuguese Bench Siphon Well Response

As shown on **Figure C1-12**, the discharge rate from the Davis' siphon well fluctuated around an average value of approximately 4.55 gpm between November 19 and December 3 but then decreased to slightly over 4.2 gpm after test well pumping terminated. The fluctuations in well discharge rate do not appear to be related to groundwater extraction at Hay Ranch or barometric pressure fluctuations (illustrated on **Figure C1-12**), but may relate to temperature/weather changes in the mountains west of the Davis property. Because the intake for the Davis well is located at an elevation approximately 600 ft higher than groundwater table elevations in Rose Valley, no response was expected.

C1-5 Estimated Aquifer Parameters

Geologica used standard graphical methods to evaluate aquifer properties. Plots were prepared of drawdown versus the logarithm of elapsed time (semi-log plots) for data from the Hay Ranch North and South wells, and the Coso Ranch North well as shown on **Figures C1-13** through **C1-15**, respectively. Additionally, a plot of logarithm of drawdown versus the logarithm of elapsed time (log-log plot) for the Hay Ranch North Well was developed as shown on **Figure C1-16**. The Cooper-Jacob Straight-Line Method (Dawson and Istok, 1991) was used to estimate aquifer transmissivity and storage coefficients using the semi-log data plots from the Hay Ranch South well and Coso Ranch North well. Transmissivity values estimated from early well response ranged from 6,630 to 19,400 ft^2/day in the Hay Ranch wells and 165,700 ft^2/day in the Coso Ranch North well (see Table C1-5). Storage coefficients estimated for the Hay Ranch North well and Coso Ranch North well were 0.00077 and 0.0014, respectively. Later well response exhibited decreasing rates of groundwater table drawdown with time indicative of vertical drainage. These are considered to be rough estimates because the Jacob-Cooper time constraint was not met for portions of the early time data and the analysis method is intended for confined aquifers.

Analysis of time drawdown data from the Hay Ranch North well using the Neuman (1975) delayed yield type-curves indicated an aquifer transmissivity of 14,750 ft^2/day and storage coefficient of 0.001. Assuming a saturated thickness of 600 ft, these results indicate a horizontal hydraulic conductivity of approximately 25 ft/day. The vertical hydraulic conductivity of the aquifer was estimated to be 0.01 ft/day using a Neuman

"Beta" coefficient of 0.01 from the type curve match and an aquifer thickness of 600 ft. The time-drawdown data from the Hay Ranch North well are considered to provide the best indication of aquifer response because drawdown in the well substantially exceeded interferences from barometric pressure and other wells pumping. The Neuman delayed yield type curves appeared to give the best match to observed time drawdown data from the November/December 2007 pumping test. The aquifer may best be described as "semi-confined" as it is unconfined near the water table and becomes increasingly confined by clay and silt layers with increasing depth below the water table.

Aquifer specific yield (as opposed to storage coefficient) could not be estimated using graphical methods because the change in time-drawdown response characteristic of unconfined aquifer response (decrease in water level drawdown rate) was not fully developed during the 14 day pumping test.

C1-6 Discussion and Conclusions

COC conducted a 14 day constant rate pumping test between November 19 and December 3, 2007 using a pump installed in the Hay Ranch South well and monitoring groundwater levels in 11 wells located throughout Rose Valley. The greatest response to pumping was observed in the pumped well (107 ft of drawdown) and the Hay Ranch North well (6 ft of drawdown), approximately 2,750 ft north of the pumped well. Wells (Coso Ranch North and Coso Junction Store #1) in Coso Junction, 2 miles south of the pumped well, drew down as much as 0.4 ft during the test. Wells on Navy property 5 to 7 miles south of the pumped well did not appear to respond to pumping nor did a well located at the north end of the Little Lake Ranch property, 8 miles south of the pumped well. Changes were observed in the groundwater discharge rate from the Davis siphon well at Portuguese Bench that did not appear to be correlated with test pumping.

In general, aquifer response was consistent with that of a stratified, semi-confined aquifer. In this type of system, the aquifer would be expected to respond initially as if it were confined, and exhibit low storage coefficients, then as time goes on, vertical movement of groundwater from higher in the aquifer reaches the well screen causing a gradual reduction in the rate of groundwater level drawdown. If pumping continues for long periods of time at high rates, a second pronounced decrease in the rate of groundwater level decline is expected as soil near the groundwater table actually becomes dewatered. During the 2007 pumping test, the time-drawdown plots from the wells on the Hay Ranch property showed the initial rapid decline characteristic of low storage coefficients, then gradually drew down more slowly towards the end of the test indicating recharge from higher in the aquifer. However, specific yield could not be estimated based on data collected during the 2004 or 2007 pumping tests. As such, uncertainty in this parameter will have to be addressed using sensitivity analysis in the groundwater modeling analysis presented in Appendix C2.

The most significant finding of the 2007 pumping test was that the vertical hydraulic conductivity of the aquifer was estimated to be approximately three orders of magnitude lower than the horizontal hydraulic conductivity in the central part of Rose Valley. This

is not unexpected because drillers' logs for wells drilled in the valley frequently report clay interbeds between sequences of sands and gravels; the presence of these clay layers impedes vertical groundwater flow. The effect of this natural vertical anisotropy is two-fold: it reduces the rate at which groundwater moves down from the water table, that is, it increases the time required before the onset of unconfined aquifer conditions, and, it increases the lateral distance at which pumping effects are propagated compared to a more uniform sand and gravel aquifer. Because the groundwater flow model developed for Rose Valley in 2006 used higher vertical hydraulic conductivity values, it may underestimate groundwater table drawdown developed at distance from the Hay Ranch pumping wells. Evaluation of the significance of this finding is presented in Appendix C2.

C1-7 References

Bauer, C.M., 2002, "The Hydrogeology of Rose Valley and Little Lake Ranch, Inyo County, California, Appendix Eight, Well Logs for Southern Owens and Rose Valleys", Master's Thesis, California State University, Bakersfield, April 2002.

Brown and Caldwell, 2006, "Rose Valley Groundwater Model", Coso Operating Company, LLC, Rose Valley, California, April 10, 2006.

Dawson, K.J. and J.D. Istok, 1991, Aquifer Testing, Design and Analysis of Pumping and Slug Tests, Lewis Publishers, Chelsea, Michigan, pgs. 54-55.

Geologica , 2007, "*Draft Hay Ranch Pumping Test Work Plan Conditional Use Permit Hay Ranch Water Extraction and Delivery Project-Hydrology Review*", November 6, 2007.

GeoTrans, 2003, "*Results of Aquifer Tests, Hay Ranch Production Wells, Rose Valley, Coso Junction, California",* (report), prepared for Coso Operating Company, LLC, October 13, 2003.

Hay Ranch, 1971, Water Well Drillers Reports, Hay Ranch Irrigation Wells #1 and #2.

Navy, 2003, *Generalized Lithologic Log of Well 18-28*.

Neuman, S.P., 1973, "Theory of flow in unconfined aquifers considering delayed response of the water table", Water Resources Research, Vol. 8, No. 4, pp. 1031-1045.

APPENDIX C2

NUMERICAL GROUNDWATER FLOW MODELING

ROSE VALLEY, INYO, COUNTY, CALIFORNIA

APPENDIX C2
NUMERICAL GROUNDWATER FLOW MODELING
ROSE VALLEY, INYO, COUNTY, CALIFORNIA

C2-1 Introduction

This appendix describes the numerical groundwater flow model developed for the Rose Valley, California, groundwater basin for the Environmental Impact Report (EIR) being prepared by MHA|RMT on behalf of Inyo County for the Coso Operating Company (COC) Water Extraction and Delivery System Project ("the Project"). For this project, GEOLOGICA, Inc. (GEOLOGICA) revised and recalibrated a numerical model previously developed by Brown and Caldwell (2006) for the Rose Valley groundwater basin. Groundwater flow evaluations were conducted using the U.S.G.S. MODFLOW computer code (McDonald and Harbaugh, 1988) implemented in the Groundwater Vistas graphical environment (Environmental Simulations, 2007).

C2-1.1 Purpose

The purposes of the evaluations and analysis described in this appendix were: to evaluate the groundwater conditions; analyze the potential impacts to groundwater resources in Rose Valley according to CEQA guidelines; and, to define mitigation measures to reduce potentially significant effects of the construction and operation of the proposed COC Hay Ranch project.

C2-1.2 Scope

The scope of this task included evaluating information regarding hydrogeologic conditions in Rose Valley, revising an existing numerical groundwater flow model of Rose Valley developed by Brown and Caldwell (2006) as needed to better represent those conditions, calibrating the model to new data from a pumping test conducted in November/December 2007, and developing scenarios to evaluate the proposed project, alternatives to the proposed project, and possible mitigation measures to reduce the impact of the proposed project. In addition, GEOLOGICA conducted sensitivity analyses to evaluate the impact of uncertainty in various input parameters and various withdrawal scenarios on model predictions.

C2-2 Environmental Setting

C2-2.1 Physiography

Rose Valley is a long, narrow valley located on the eastern flank of the Sierra Nevada Mountains in Inyo County, California. The alluvial portion of the groundwater basin is approximately 16 miles long from the southern end of the Haiwee Reservoir to just south of Little Lake, and has a maximum width of approximately 6 miles at its widest point. Rose Valley is topographically separated from the Owens Valley to the north by Dunmovin Hill, a topographic high that is composed of a massive landslide or series of debris flow deposits that originated from the Sierra Nevada range to the west (Bauer, 2002). Rose Valley is separated from the Indian Wells Valley to the south by a topographic high formed by a combination of granitic rocks and volcanic flows, and by the Little Lake Gap, which is an approximately 1,000 ft wide water-carved canyon within

the volcanics (Bauer, 2002). **Figure C2-1** depicts physiographic features of the study area. The ground surface of the valley floor generally slopes gently to the south at a rate of 30 to 35 feet per mile.

C2-2.2 Geology

Rose Valley is a graben surrounded and underlain by igneous and metamorphic basement rocks of the Sierra Nevada and Coso Ranges. Alluvial sediments were encountered to depths as great as 3,489 feet in borings advanced in the north central portion of the basin (Schaer, 1981) and may extend to depths greater than 5,000 feet below ground surface (bgs) based on gravity surveys (GeoTrans, 2004). Younger (30 to 0.4 million years old) volcanic rocks of the Coso Range outcrop east of the central and northern Rose Valley and are predominately rhyolitic, dacitic, and andesitic in composition. The southern boundary of the Rose Valley groundwater basin is marked by outcrops of volcanic rocks related to eruptions within or flows from the Coso Range and volcanic cinder cones in the Red Hill area.

As summarized by Bauer (2002), the basin fill consists, in descending order, of recent alluvial fan deposits including debris flows from the bordering Sierra Nevada Mountains, volcanic deposits including basalt, ash, cinders, and tuff, lacustrine deposits of the Coso Formation, and older alluvial fan deposits from the Sierra Nevada and Coso Ranges. The recent alluvial deposits usually occur between ground surface and depths of up to 800 ft, and consist of a mixture of sands and gravels interbedded with clay. The maximum drilled thickness of these deposits occurs in the north central part of the valley near the Hay Ranch property. The Coso Formation uncomformably overlies basement rocks in the Coso Range and Rose Valley, and is comprised of a heterogeneous assemblage of primarily lacustrine deposits, with lesser amounts of volcanic tuff and alluvial fan deposits. Bauer (2002) described the Coso Formation as being comprised of four members in descending stratigraphic order: the Rhyolite Tuff Member, the Coso Lake Beds Member, the Coso Sand Member, and the Basal Fanglomerate Member.

- The Rhyolite Tuff Member occurs along the east side of the southern Haiwee Reservoir and extends south into the north end of the valley along the western slope of the Coso Range.
- The Coso Lake Beds Member reportedly is composed of alternating beds of fine-to-coarse-grained sand, arkosic, green clay with interspersed volcanic ash, and thin-bedded white rhyolitic tuffs containing pumice fragments. Deposits of the Coso Lake Beds Member reportedly extend north into the southern Owens Valley, where it is known as the Owens Lake Bed Member.
- The Coso Sand Member consists of poorly consolidated, fine-to-coarse grained alluvial gravels, sand, and red clay beds derived from the granitic basement rocks of the Coso Range and reworked Sierra Nevada alluvial fan materials. The Coso Sand Member occurs at depths from 1,500 ft to 3,000 ft bgs and the unit is thickest to the west, decreasing in thickness rapidly to the east.
- The Basal Fanglomerate Member was infrequently encountered in well borings drilled in the valley. It consists of reworked colluvial deposits localized by basement topography and structures.

C2-2.3 Hydrogeology

C2-2.3.1 Hydrostratigraphic Units

The principal hydrostratigraphic units that comprise the Rose Valley aquifer consist of recent alluvial deposits, and the Coso Lake Bed and Coso Sand Members of the Coso Formation. Older bedrock is largely impermeable or low permeability and typically impedes or excludes groundwater flow.

C2-2.3.2 Groundwater Occurrence and Flow

The groundwater table is typically first encountered during drilling within the upper portion of the recent alluvial deposits. Depth to groundwater ranges from 140 to 240 ft bgs in the north and central parts of Rose Valley to approximately 40 ft bgs at the northern end of the Little Lake Ranch near the south end of the valley. Depth to groundwater and calculated groundwater elevation used to develop the November 2007 groundwater elevation contour map are tabulated in **Table C2-1**. It should be noted that COC engaged triad / holmes associates in November 2007 to survey the location and reference point elevations of wells used for groundwater level measurements. These wells had not previously been surveyed. A groundwater elevation contour map of Rose Valley developed from depth to water measurements made on November 19, 2007 (**Figure C2-1)** indicates southeasterly groundwater flow along the axis of the northwest to southeast trending valley. With one exception, the November 2007 monitoring results were consistent with observations reported by Bauer (2002) for data collected in 1998. Water level measurements in Navy well 18-28, located in southeastern Rose Valley (**Figure C2-1**) indicated that the groundwater elevation in this area was approximately 10 ft higher than expected. This well was not available to previous investigations. The higher groundwater elevation is believed to be the result of impeded groundwater flow through the volcanic deposits south of the Red Hill cinder cone, towards Little Lake, and/or groundwater upwelling from the geothermal system underlying the Coso Range to the northeast.

Because the ground surface slopes more steeply to the south than the groundwater table, the groundwater table surfaces at and discharges from springs beneath Little Lake, sustaining the lake and the surface water discharge across the Little Lake Weir (see **Figure C2-2** for locations). Additional groundwater discharges from Coso Spring and the Little Lake Ranch siphon well as the ground surface elevation drops more steeply to the south of Little Lake.

Long term groundwater level monitoring conducted by COC indicates that groundwater levels have generally risen 1 to 2 feet throughout Rose Valley over the last 5 years (see **Figure C2-3**). This is most likely a response to increased precipitation recharge in the mountains during the last few years. There were no significant changes in groundwater extraction in Rose Valley nor identified groundwater recharge other than precipitation infiltration at higher elevations (discussed in Section C2-2.5). An approximately 1 ft rise was observed in the Cal-Pumice well north of the Hay Ranch property, 1.5 ft rises were observed in Lego and G-36 wells on Navy property seven miles southeast of Hay Ranch, and 2 ft rises were observed in the Hay Ranch wells. Groundwater levels in the LADWP wells (V816 and V817) fell from 2002 to mid-2005 then rose until the spring of 2007 when they began falling again.

The groundwater levels in the LADWP wells 2 miles south of the Haiwee Reservoir were approximately 170 ft higher than groundwater levels in the closest monitored well to the

south, Cal-Pumice, throughout the long term monitoring period, suggesting a surface water flow component or input from a groundwater basin at a different groundwater elevation potential (i.e., Owens Valley). Groundwater levels in the LADWP wells were more variable than any other wells in the valley. The source of this variation is not well known. Water levels in Haiwee Reservoir and the flow rate in the LADWP aqueduct rose during the time water levels were monitored for the 2007 pumping test while groundwater levels in the LADWP wells fell; positive correlation between rising reservoir levels and groundwater elevation would be expected if seepage from the reservoir strongly influenced groundwater levels. The absence of correlation between reservoir levels and groundwater levels in the LADWP wells suggests varying rates of groundwater influx from Owens Valley may be the cause of groundwater level fluctuations at the north end of Rose Valley. Groundwater level monitoring data collected by COC beginning in September 2001 are tabulated in **Table C2-2**. Long term monitoring well locations are shown on **Figure C2-1**.

C2-2.3.3 Aquifer Properties

The transmissivity of the upper portion of the alluvial deposits was previously estimated to range from 9,000 to 69,800 gpd/ft (1,200 to 9,330 ft^2/day) based on data presented in the Rockwell Report (1980). Based on 24-hour pumping tests conducted in the Hay Ranch wells, GeoTrans (2003) concluded that the transmissivity of the Rose Valley aquifer near Hay Ranch was approximately 10,000 ft^2/day and estimated that the (horizontal) hydraulic conductivity was approximately 20 ft/day. GeoTrans concluded that they had insufficient data to estimate aquifer storage properties.

Based on a 14-day pumping test conducted in the Hay Ranch South well and monitored in wells throughout the valley, GEOLOGICA concluded that the best estimate of the transmissivity and horizontal hydraulic conductivity of the aquifer were approximately 14,750 ft^2/day and 24 ft/day, respectively (see Appendix C1). The vertical hydraulic conductivity of the alluvial aquifer in central Rose Valley was estimated to be 0.01 ft/day using a Neuman “Beta” coefficient of 0.01 from the aquifer testing type curve match and an aquifer thickness of 600 ft. The storage coefficient applicable to early time response and saturated soil below the water table was found to be 0.001.

C2-2.4 Surface Water

The average annual precipitation in Rose Valley ranges from 5 to 7 inches while the area’s annual evapotransporation rate is estimated to be 65 inches (CWRCB, 1993). Consequently, surface water bodies in the Rose Valley area consist of perennial springs sustained by groundwater flow, ephemeral streams and washes that mainly flow in the winter, and manmade lakes and reservoirs. Surface water features of interest are shown on **Figure C2-1** and discussed below.

C2-2.4.1 Haiwee Reservoir

The South Haiwee Reservoir is located at the north end of Rose Valley approximately 4 miles north of Hay Ranch. The crest of the south Haiwee Dam is located at approximately 3,766 ft MSL. Because of seismic stability concerns, the water level in the reservoir is currently limited to a maximum elevation 3,742 ft MSL. During construction of the dam, a trench was reportedly excavated to a depth of up to 120 ft below ground surface, until it tagged basalt bedrock, and backfilled with clay to seal the base of the dam (LADPS, 1916); however, the remainder of the reservoir is unlined. Weiss (1979) estimated that underflow from Haiwee Reservoir contributed approximately 600 acre-ft of

water per year to the Rose Valley groundwater basin, indicating that the Reservoir is potentially an important source of recharge.

C2-2.4.2 Springs and Siphon Wells

Bauer (2002) identified several springs in Rose Valley including:

- Rose Spring located approximately 2 miles south of Haiwee Reservoir
- Tunawee Canyon Spring located approximately 3 miles southwest of the Hay Ranch
- Davis Siphon Well Spring located at Portuguese Bench
- Little Lake Fault Spring and Little Lake Canyon Spring located near the south end of Rose Valley, and
- Coso Spring located on the Little Lake Ranch property southeast of Little Lake.

Approximate spring locations are shown on **Figure C2-1**. As shown on Figure C2-1, only the Rose Spring is located within the numerical model grid area. No data were identified regarding the groundwater discharge rates from the Rose, Tunawee Canyon, Little Lake Fault, or Little Lake Canyon Springs. The groundwater discharge rate from the Davis Spring, referred to as the Davis Siphon Well in Appendix C1, was measured during the November/ December 2007 pumping test and ranged from 4.5 to 4.2 gallons per minute (gpm) or approximately 7 acre-ft/yr. The Davis Spring is located on the west central side of Rose Valley at Portuguese Bench at an elevation of approximately 3,870 ft MSL. Because the Davis Siphon well and spring discharge are located more than 600 ft higher than the groundwater table in the Rose Valley aquifer east of the Davis property at Coso Junction, they are not directly hydraulically connected to the alluvial aquifer. As discussed in Appendix C1, monitoring of the spring discharge rate during the 2007 pumping test did not provide any evidence of impact to the spring from pumping at Hay Ranch. Discharge from the spring that is not used on the Davis property infiltrates back into the ground after which it percolates downward to recharge the alluvial aquifer.

Based on their locations, elevations, and isotope chemistry (discussed in Section 3.2), the source of water for the Tunawee Canyon, Davis, and Little Lake Canyon springs is mainly derived from precipitation recharge in the Sierra Nevada mountains, while that for the Rose Spring appears to be a combination of Sierra Nevada precipitation recharge and seepage from Owens Valley and Haiwee Reservoir. Because the Tunawee Canyon, Davis, and Little Lake Canyon springs are located outside of the main body of the Rose Valley aquifer at elevations above the groundwater table in the Rose Valley aquifer and derive their water source wholly or mainly from Sierra Nevada precipitation recharge, they are unlikely to be impacted by the proposed project. The Rose spring, located near the north end of Rose Valley at an elevation (3,580 ft MSL) approximately 300 ft above the groundwater table in the aquifer, is also unlikely to be impacted by the proposed project. Based on its isotope chemistry, location, and elevation, Coso Spring, on the Little Lake Ranch property, is partially or wholly sourced by groundwater flowing from Rose Valley. Discharge from Coso Spring likely will be influenced by changes in groundwater conditions in Rose Valley; however, the spring is outside (south of) the model grid and is not directly represented in the model.

At the south end of Rose Valley, groundwater flow through the Little Lake Gap is constrained by bedrock on the west, an apparent subsurface bedrock rise below, and low or reduced permeability in the basalt lava flows to the east. The ground surface in

the area slopes to the south, gently between the northern property line and Little Lake, then more steeply south of Little Lake. As a result of the combination of south-sloping ground surface and bedrock barriers to lateral or vertical groundwater flow, groundwater surfaces in this area to discharge via submerged springs into Little Lake and from the Coso Spring southeast of Little Lake (Figure C2-2). Groundwater discharging from the Coso Spring flows into the upper Little Lake pond (P-1). A siphon well located south of Little Lake (below the elevation of Little Lake and Coso Spring) brings additional groundwater to the surface where it is piped to the lower Little Lake pond (P-2). The intake for the siphon well is lower than the Little Lake Weir but higher than the Coso Spring. The siphon well is believed to be screened between elevations of approximately 3,120 and 3,130 ft MSL. Coso Spring is located at an approximate elevation of 3,120 ft MSL.

Little Lake Ranch staff can control the water level in the lake, allowing it to rise in the winter and fall in the summer by adjusting the height of a weir located at the south end of the lake. Overflow from the Little Lake weir is conveyed to the upper Little Lake pond (P-1) through an open channel. The discharge from both ponds flows through an open channel to the south where it is used to fill additional ponds when flow is adequate. As a result of evapotranspiration and infiltration, none of the surface water on the Little Lake Ranch property flows off the property (ULLR, 2000).

The only spring flow and groundwater discharge rate data for the Little Lake Ranch property were reported in Bauer (2002). Bauer (2002) measured the discharge rate from Little Lake, the flow rate from Coso Spring, and the stream flow rate in the North Culvert, south of pond P-2 and South Culvert, at the south end of the property, several times between 1996 and 1998. These data are summarized in **Table C2-3** and schematically illustrated on **Figure C2-4**. Bauer did not measure the flow rate from the siphon well. The North Culvert captures flow from the Little Lake Weir stream, Coso Spring, and the discharge from the upper and lower ponds. Bauer's measurements do not include evapotranspiration losses in the pond or conveyance system or identify possible measurement errors. As shown on **Figure C2-4**, the flow rate from Coso Spring ranged between 1,000 and 2,000 acre-ft/yr, averaging approximately 1,500 acre-ft/yr. The discharge rate from the Little Lake Weir ranged from zero in the summer of 1997 to 1,750 acre-ft/yr in the winter of 1998, averaging approximately 800 acre-ft/yr. In dryer years, e.g., 1997, Little Lake apparently does not discharge water across the weir in summer months.

C2-2.4.3 Lakes

One perennial lake, Little Lake (also described above), is located at the south end of Rose Valley approximately 9 miles south of the Hay Ranch property (**Figures C2-1** and **C2-2**). The U.S.G.S. Little Lake quad topographic map places the elevation of the lake at approximately 3,145 ft MSL. The lake is reportedly 3 to 5 ft deep and covers an area of approximately 75 to 90 acres at its maximum extent. The water level in the lake can be manipulated by raising or lowering boards in a discharge weir located at the south end of the lake but is also influenced by evaporation in the summer, as well as direct rainfall and storm water inflow from Little Lake Canyon wash to the west in the winter.

Bauer (2002) monitored the water level in the lake and the groundwater level in a monitoring well near the north end of the lake between January 6, 1997 and March 21, 1998. The variation in water level in Little Lake and groundwater elevation adjacent to the lake during that period is illustrated on **Figure C2-4**. The water level in the lake decreased nearly 1 foot between January and August and then rose nearly 1.2 foot in

the following fall and winter. Any adjustments to the discharge weir in that time period were not noted by Bauer. Groundwater elevation measured in a well located approximately 500 feet from the north shore of Little Lake dropped nearly 0.8 ft between spring and summer 1997 and rose nearly 1 foot in the winter and following spring, but was always 3 foot or more higher than the lake level, indicating that the lake was always fed by groundwater. From this figure it appears that discharge of water from the Little Lake Weir stopped when the lake level dropped below approximately 3,142 ft but increased to an annualized rate of 1,750 acre-ft/yr when the lake water level rose to 3,143 ft MSL. Over this same period the discharge rate from Coso spring actually increased when the lake stopped discharging and decreased when the lake resumed discharging, indicating that the hydrologic system in this area is very complex. Based on these data, naturally occurring groundwater level fluctuations of 1 ft measured 500 ft north of Little Lake appears to correlate with significant changes in surface water flow rates on the Little Lake Ranch property.

C2-2.5 Groundwater Flow Components and Water Budget

The Rose Valley groundwater system is primarily recharged by mountain front recharge derived from precipitation and snowmelt that falls at higher elevation in the Sierra Nevada front range. As noted in Section C2-2.3.2, the south sloping groundwater table observed at the north end of Rose Valley indicates groundwater enters Rose Valley from Owens Valley to the north and/or from seepages losses from the south Haiwee Reservoir. This inflow is incorporated into the model.

As discussed in Section 3.2, some precipitation recharge likely occurs in the Coso Range on the east side of the valley but was conservatively neglected for the current modeling effort. Also, perhaps as much as 250 acre-ft/yr of groundwater may enter southeastern Rose Valley as upwelling from the Coso geothermal system based on proportions of chloride and stable isotopes in groundwater in southeastern Rose Valley, but was conservatively neglected in this analysis. Leakage from the LADPW aqueducts that traverse Rose Valley was assumed to be a negligible component of total groundwater inflow to the basin.

Currently, the principal groundwater outflow components consist of groundwater underflow and surface water discharges to the Indian Wells Valley to the south, and evapotranspiration from Little Lake and phreatophytic vegetation on the Little Lake Ranch property. Because of the dry climate, essentially all of the precipitation falling on Rose Valley is lost to evapotranspiration. However, because the groundwater table is located 40 or more feet below ground surface over all but the southern tip of the valley, evapotranspiration does not factor into the groundwater budget except on the Little Lake Ranch property. Inflow and outflow components of the groundwater budget for Rose Valley are discussed in more detail below.

C2-2.5.1 Groundwater Inflow Components

Principal inflow components consist of mountain front recharge, groundwater inflow from Owens Valley to the north and/or seepage from Haiwee Reservoir.

Mountain Front Recharge

Precipitation recharge in the Sierra Nevada range west of Rose Valley is the principal source of groundwater to the Rose Valley basin. Due to the rain shadow effect caused by the Sierra Nevada's, the precipitation rate in the Coso Range on the east side of Rose Valley is low. To be conservative, it was assumed that the evapotranspiration

potential exceeded potential precipitation recharge throughout Rose Valley and the Coso Range. Methodologies to directly measure mountain front recharge are poorly defined; typically groundwater recharge from precipitation is estimated as a percentage of total recharge.

Brown and Caldwell (2006) concluded that precipitation rates in the Rose Valley area range from about 6 inches per year (in/yr) on the valley floor to up to 20 in/yr at the crest of the Sierra Nevada range and that only precipitation falling at elevations above 4,500 ft results in groundwater recharge. In the mountains, precipitation rate (including rainfall and snow melt) is strongly dependent on altitude. Danskin (1998) established an empirical relationship between precipitation rate and altitude based on precipitation and snow records collected routinely for more than 50 years in 20 survey stations along the western side of Owens Valley. Using the empirical relationship developed in the Danskin report, Brown and Caldwell estimated that the average precipitation rate for the elevation ranging from 4,500 ft to 6,500 ft was 10 in/yr, increasing to 15 in/yr for parts of the watershed above 6,500 ft. Using a geographic information system (GIS), to evaluate the contribution from areas of varying elevation in the Sierras west of Rose Valley, Brown and Caldwell estimated that the total precipitation volume that could potentially recharge the Rose Valley groundwater basin was approximately 42,000 acre-ft/yr.

For the purposes of the initial evaluation of potential impacts of groundwater development at Hay Ranch, they further assumed that only 10 % (4,200 acre-ft/yr) of the potential mountain front precipitation recharge actually reaches Rose Valley. Danskin (1998) used a value equivalent to 6% of Sierra Nevada range precipitation for the mountain front recharge component of the numerical groundwater flow model developed to evaluate groundwater development in Owens Valley. Williams (2004) estimated that mountain front precipitation recharge in Indian Wells Valley amounted to approximately 8% of precipitation in the Sierra Nevada range to the west. However, Williams noted that the Maxey-Eakin Method for estimating precipitation recharge in the Sierra Nevada range conservatively neglects areas receiving less than 8 in/yr of precipitation; consequently, higher recharge rates are possible. Because the mountain front precipitation recharge rate as assumed for the Brown and Caldwell groundwater flow model yielded reasonable calibration results in the steady state model, a recharge rate of 4,200 acre-ft/yr was also used in the revised numerical model developed for this EIR.

Groundwater Inflow/Seepage from the North

As noted previously, Weiss (1979) estimated seepage losses from the Haiwee Reservoir to be on the order of 600 acre-ft/yr. Previous investigators (Bauer, 2002; Brown and Caldwell, 2006) and GEOLOGICA's review of groundwater elevation contour patterns in the north end of Rose Valley indicate that groundwater inflow from southern Owens Valley and/or seepage losses from the south Haiwee Reservoir recharge the Rose Valley groundwater basin at the north end of the valley. Using a steady-state numerical groundwater flow model of the Rose Valley groundwater basin, Brown and Caldwell (2006) estimated the groundwater influx from the north to be approximately 788 acre-ft/yr, which is similar to the estimate of Weiss (1979). Recalibration of the numerical groundwater flow model for this study indicated a slightly higher groundwater inflow rate from the north (Owens Valley/Haiwee Reservoir) of 890 acre-ft/yr.

C2-2.5.2 Groundwater Outflow Components

Principal groundwater outflow components from Rose Valley consist of discharge to the Indian Wells Valley from the Little Lake area and an area in the southeast part of the

valley, east of Red Hill, and evapotranspiration in the Little Lake area. Limited groundwater extraction was identified in Rose Valley.

Groundwater Discharge from Southeastern Rose Valley

Brown and Caldwell (2006) estimated that approximately 2,050 acre-ft/yr of groundwater discharges from Rose Valley in the southeast part of the valley (southeast of Navy well 18-28) as underflow to Indian Wells Valley. Williams (2004) concluded that existing estimates of recharge to the Indian Wells Valley significantly underestimated interbasin transfers and referenced an estimate of groundwater underflow from Rose Valley to Indian Wells Valley of 10,000 acre-ft/yr developed by Thompson (1929). Recalibration of the numerical groundwater flow model for Rose Valley indicated an underflow rate from Rose Valley to Indian Wells Valley in this area of 850 acre-ft/yr. This is less than half the value of 2,050 acre-ft/yr assigned to this term in the Brown and Caldwell (2006) numerical modeling analysis. This difference is discussed in the model calibration section.

Groundwater Discharge at Little Lake

Groundwater discharge by several processes in the Little Lake area is the dominant outflow component from Rose Valley. The processes operating at Little Lake include:

- Evaporation from the lake surface;
- Transpiration from phreatophyte plants on the property;
- Discharge from Coso Spring;
- Discharge from the Little Lake Weir; and
- Discharge from the Little Lake Siphon well.

Bauer (2002) estimated that evaporation from the Little Lake water surface consumes approximately 500 acre-ft/yr based on a lake surface area of 75-90 acres and evaporation rate of 80 in/yr. As discussed in Section 3.4, plant communities identified on the Little Lake Ranch property were described as akalai desert (saltbush scrub), palustrine (pond) and lacustrine (lake) wetlands, and riparian (creek) habitat. Beginning in 2000, Little Lake Ranch, Inc., conducted various projects intended to restore or enhance 90 acres of lacustrine wetlands, 10 acres of palustrine emergent wetlands, about 6 acres of palustrine/riparian habitat (1.6 mile long creek corridor), and an additional 220 acres of wetland and upland habitat, and 1 acre of wetland and associated upland habitat was acquired. As a result of shallow groundwater in this area, at least 300 acres of the 1,200 acre Little Lake Ranch property hosts various species of plants. Studies summarized in the U.S.G.S. Water-Supply Paper for Owens Valley (Danskin, 1998) concluded that wet land plant species in the desert climate prevalent in Owens (and Rose Valley) transpire between 20 and 36 in/yr. Using an average evapotranspiration value of 28 in/yr over the 300 acres yields an estimated 700 acre-ft/yr for transpiration processes (in addition to 500 acre-ft/yr assumed for surface water evaporation from Little Lake). Consistent with the 2006 numerical model, the model grid extends to the south end of Little Lake, as a result evaporation from ponds and the outfall stream and evapotranspiration from plants on the Little Lake Ranch property south of Little Lake are not explicitly represented in the model. Consequently, the evapotranspiration component of the 2007 numerical model includes 500 acre-ft/yr for evaporation from Little Lake and 200 acre-ft/yr for evapotranspiration from plants around the lake.

As discussed in Section C2-2.4.2, the flow rate measurements in the North Culvert, south of the lower pond (P-2) captures the discharge from the Little Lake Weir, Coso Spring, and Little Lake Siphon well. The discharge rate measured in the North Culvert ranged from 885 to 5,357 between January 6, 1997 and March 21, 1998 and averaged 3,000 acre-ft/yr. The domestic well by the ranch house, several irrigation wells, and the former Little Lake Hotel well are not believed to extract significant quantities of groundwater. The combined total of measured lake, spring, and groundwater discharges and estimated evapotranspiration losses in the Little Lake Ranch area is approximately 4,200 acre-ft/yr. All of the groundwater discharged in the Little Lake area that is not evaporated or transpired by plants (represented by flow observed at the North Culvert) infiltrates back into the ground on the property (approximately 3,000 acre-ft/yr) and continues as groundwater underflow to Indian Wells Valley (no surface water flow leaves the property). This is slightly lower than the value of 3,300 acre-ft/yr estimated by Williams (2004) for interbasin transfer from Rose Valley to Indian Wells Valley but does not include the groundwater underflow component from the southeastern Rose Valley discussed in the previous section.

Existing Extraction Wells

Currently, approximately 50 acre-ft/yr of groundwater production from wells occurs in Rose Valley. No significant agricultural irrigation has occurred in the valley since the Hay Ranch ceased alfalfa growing operations. As many as 30 domestic wells are believed to extract relatively small quantities of groundwater for domestic uses and small scale irrigation in the Dunmovin area. This pumpage is not represented in the groundwater flow model because it is believed to amount to less than 10 acre-ft/yr. The LADWP, Cal-Pumice, and Hay Ranch wells are not being pumped and are not known to have been used in the last five years. The Coso Ranch South well, southern Coso Junction Store well (Coso Junction #2), and the Cal Trans well at Coso Junction are regularly used for businesses in the area. The Coso Ranch North well and northern Coso Junction Store well (Coso Junction #1) are not being used at present. Cal-Pumice and the cinder mine near Red Hill reportedly takes 5 to 10 truckloads of water a day during the week from the Coso Ranch South well and Red Hill well, respectively, which was set in the model as a continuous withdrawal of 2005 cubic feet per day (cfd) or roughly 10 gpm. The Coso Junction Store well supplies the general store and COC offices in Coso Junction and was also represented as a continuous withdrawal of 2005 cfd. Extraction from the Cal Trans well was assumed to be negligible. Wells on the Navy property in Rose Valley including the Lego well, well G-36, and well 18-28 are not being pumped. Water wells on the Little Lake Ranch property were discussed in the previous section.

C2-2.5.3 Groundwater Budget

The groundwater elevation monitoring data suggest that groundwater inflows have equaled or slightly exceeded groundwater outflows from the Rose Valley groundwater basin in the past five years. Assuming that groundwater inflows equal outflows, that is, that steady state conditions prevail, the resulting conceptual Rose Valley groundwater budget is tabulated in the table below. Values from the 2006 numerical groundwater flow model are also listed for comparison purposes:

Table C2-4: Conceptual Groundwater Budget Components

Budget Components	2006 Model		2007 Model	
	Flow Rate, acre-ft/yr	Simulation Package used in Model	Flow Rate, acre-ft/yr	Simulation Package used in Model
Groundwater Inflow				
Mountain Front Recharge	4,191	Well	4,191	Well
Groundwater Underflow from the North	788	Constant Head	788	Constant Head
Total Inflow	4,979		4,979	
Groundwater Outflow				
Existing extraction wells	0	--	40	Well
Groundwater underflow to Indian Wells Valley exiting from southeastern Rose Valley	2,050	General Head	739	General Head
Evaporation from Little Lake and Evapotranspiration from adjacent Palustrine wetland plants	500	Evapo - transpiration	700	Evapo - transpiration
Plant transpiration on Little Lake Ranch property south of Little Lake (outside model grid)	0	--	500	--
Groundwater Discharge through Little Lake Gap to Indian Wells Valley	2,429	Drain	3,000	General Head
Total Outflow	4,979		4,979	

*Conceptual budget, simulated budget components were adjusted during model calibration process.

C2-3 Numerical Model Development

Brown and Caldwell (2006) developed a three-dimensional, numerical model of the Rose Valley groundwater basin which was then revised, and recalibrated, by GEOLOGICA for the EIR developed for the COC groundwater project at Hay Ranch. The revised model incorporates new groundwater elevation data collected by COC staff as well as time-drawdown data from a 14-day pumping test conducted at Hay Ranch in November/ December 2007. COC also engaged a surveyor in November 2007 to survey well

locations and elevations which allowed a more accurate evaluation of groundwater elevation patterns in the valley than has been possible in the past.

The revised model is intended to represent the structure of the local aquifer system, as well as the inflow and outflow components discussed in previous sections. A steady-state version of the model was first (re)calibrated using groundwater elevation measurements made on November 19, 2007, prior to the start of the constant rate pumping test at Hay Ranch. The steady-state model incorporated available information regarding aquifer boundary conditions, discharge data measured at Little Lake, and pumping and recharge estimates discussed in Section C2-2. The steady-state model was then modified to a transient model by adding storage terms for saturated soil below the groundwater table (storage coefficient) and soil at the water table (specific yield) and calibrated to time-drawdown observations from the November/December 2007 pumping test. The transient version of the numerical model was then used to predict the response of the Rose Valley aquifer system proposed Hay Ranch project development alternatives as well as the added effect of pumping by the LADWP at it's wells at the north end of the valley. The model design and setup are discussed in detail in the following sections.

Groundwater flow evaluations were conducted using the U.S.G.S. MODFLOW computer code (McDonald and Harbaugh, 1988) implemented in the Groundwater Vistas graphical environment (Environmental Simulations, 2007).

C2-3.1 Model Domain and Finite Difference Grid

The model domain, which remains unchanged from the Brown and Caldwell (2006) modeling evaluation, covers 132 square miles, extending 8.25 miles in the east-west direction and 16 miles in the north-south direction. The model domain extends from the groundwater divide near the south Haiwee Reservoir on the north to the Little Lake Gap area to the south, and is bounded by impermeable boundaries representing the Sierra Nevada Mountains on the west and by Coso Range to the east. **Figures C2-1** and **C2-2** illustrate the location of the finite-difference grid relative to pertinent features of the Rose Valley basin. Consistent with the representation developed in the 2006 numerical model, the southern edge of the active portion of the model grid extends to the south edge of Little Lake; consequently, Coso spring, the Little Lake Ranch siphon well, and palustrine and riparian wetland areas south of Little Lake are not explicitly represented in the model.

The model domain was discretized into 64 rows and 33 columns. The cell size of the grid is 1/4 mile in both length and width, representing a 40-acre area. No flow (inactive) model cells were specified along the east and west margins of the model domain to represent the shape of the aquifer within basin fill deposits.

C2-3.2 Model Layer Configuration

Three model layers were originally used to represent the aquifer system in Rose Valley. As part of the recalibration process, GEOLOGICA subdivided the uppermost model layer into two layers to better represent the semi-confined behavior of the aquifer. The location of the contact between layer 1 and 2 was specified as being just below the bottom depth of shallower wells in the valley (including Cal-Pumice, Coso Store #1 and #2, and the Lego, G-36, and 18-28 wells) which is on the order of 400 ft bgs. The uppermost two layers (layers 1 and 2) were configured to represent: debris flows and debris avalanche in the Dunmovin Hill in the northern part of Rose Valley; the recent alluvial deposits in the center of Rose Valley, and interbedded volcanic deposits and alluvium in the south

and southeast part of Rose Valley. Layer 1 was specified as unconfined with transmissivity determined by MODFLOW as the product of horizontal hydraulic conductivity and current saturated thickness and storage represented using specific yield. Layers 2, 3, and 4 were configured as confined units in MODFLOW with transmissivity calculated as the product of horizontal hydraulic conductivity and the layer thickness at that location and storage represented using a confined aquifer storage coefficient. Layer 3 was configured to represent the Coso Lake Beds Member and modeled as confined as described above. Layer 4 was configured to represent the Coso Sand Member and modeled as confined as described above.

Model layers 1 and 2, together, 3, and 4, were constructed to have variable thickness and spatial extent. The basis for specifying layer thickness and the bottom elevation of each of layers 2, 3, and 4 is described in Brown and Caldwell (2006). Contour maps of the bottom elevations of layers 1, 2, and 3 are depicted in the Brown and Caldwell report (Figures 8, 9 and 10) corresponding to the bottom elevations of layers 2, 3, and 4 in the current model. Total model thickness from land surface ranged from 150 ft within Little Lake Gap to 3,500 ft near Hay Ranch.

C2-3.3 Model Boundary Conditions

The active portion of the model domain is bounded on the west and east by igneous and metamorphic rocks of the Sierra Nevada and Coso Range which are presumed to be impermeable. Groundwater discharge to Indian Wells Valley in the southeast part of Rose Valley (east of Red Hill) through fractured basalt flows and/or basalt flows overlying alluvial deposits was represented using a head dependent boundary condition. Model cells that represent bedrock areas form the inactive portion of the model domain and also serve as no-flow boundaries. Boundary conditions specified in Layers 1 and 2, 3, and 4, are depicted in **Figures C2-5**, **C2-6**, and **C2-7**, respectively.

No Flow Boundaries/Inactive Cells

The location of no flow boundaries, and thereby, inactive cells in the model domain were essentially the same as those specified in the Brown and Caldwell (2006) model.

Specified Flux Boundaries

Along the western boundary of the active mode domain, Brown and Caldwell (2006) used specified flux boundaries to represent mountain front recharge derived from precipitation and snowmelt that falls on the Sierra Nevada (**Figures C2-5**, **C2-6**, and **C2-7)**. Due to the steep topography present on the east side of the Sierra Nevada Mountains, and the absence of well developed drainages on the Rose Valley basin floor, it was assumed that the mountain front recharge could infiltrate to all model layers, and the total mountain front recharge of 4,200 acre-ft/yr was distributed from top to bottom at a ratio of 2:1:2 based on hydraulic conductivity and layer thickness with less recharge assumed to infiltrate the low permeability Coso Lake Beds Member (layer 3). This resulted in specified fluxes of 1,680 acre-ft/yr in layers 1 and 2, 840 acre-ft/yr in layer 3 and 1,680 acre-ft/yr in layer 4.

Constant Head Boundary

On the northern edge of the model domain, a constant head (CH) boundary was used to represent the groundwater divide near the south Haiwee Reservoir (**Figure C2-5**). The groundwater elevation at this boundary was fixed in these cells at a value of 3,750 ft MSL based on groundwater level measurements made by Bauer in 1998 (Bauer, 2002).

Groundwater elevations at the south end of Owens Valley near the Haiwee Reservoirs most likely vary with time as a result of changes in pumping rates in Owens Valley and changes in water levels in the reservoirs. No time-series groundwater level measurement data were identified therefore this elevation is fixed in the model. The magnitude of the groundwater inflow rate across this boundary from Owens Valley and/or seepage from Haiwee Reservoir was controlled by modifying the hydraulic conductivity of the alluvium represented by layers 1 and 2 in the model during the model calibration process.

Evapotranspiration

Surface water evaporation from Little Lake and evapotranspiration from phreatophyte plants around the lake was represented using the MODFLOW Evapotranspiration (ET) package with ET cells specified in Layer 1 (**Figure C2-5**). The extinction depth for the ET cells was set to 15 ft below ground surface, the same value as was used in the 2006 model, and consistent with the value used in the USGS model of Owens Valley (Danskin, 1998). Bauer (2002) estimated the surface water evaporation rate from Little Lake to be approximately 500 acre-ft per year, presumeably when the lake is at its maximum depth. The relationship between lake level and surface area is unknown, presumably, at lower water levels the lake covers less area and may lose less water to evaporation. MODFLOW reduces the calculated evapotranspiration loss in proportion to the groundwater table depth below ground surface; no evapotranspiration occurs when the groundwater table is at or below the extinction depth (15 ft), half as much evapotranspiration is calculated when the groundwater table is located at half the extinction depth (7.5 ft) below ground surface. The evapotranspiration rate was adjusted during model calibration to yield a total evapotranspiration loss of approximately 500 acre-ft per year in the steady state model, consistent with the 2006 model.

General Head Boundaries

The groundwater outflow to Indian Wells Valley from the southeast part of Rose Valley near well 18-28 was simulated using general head boundary (GHB) cells specified in layers 3 and 4 (**Figures C2-6** and **C2-7**). GHB cells in MODFLOW allow groundwater inflow or outflow from the model at a rate dependent on the difference between groundwater elevation in the model and a specified elevation and a conductance assigned to the general head boundary cell; however, the groundwater elevation in the GHB cell is calculated by MODFLOW during a simulation, not fixed like a CH boundary cell. Brown and Caldwell used groundwater elevations measured in the Lego Well in Rose Valley and historical water level elevations measured in the Indian Wells Valley (presented in Bloyd and Robson, 1971) to estimate the flow across this boundary. The conductance and groundwater elevation in the GHB cells were adjusted during the model calibration process to better simulate groundwater elevations observed in the southeast part of Rose Valley.

The groundwater outflow to Indian Wells Valley in the Little Lake area was represented using GHB cells specified at the south end of the model grid near Little Lake (**Figure C2-5**). This is a departure from the treatment of these groundwater outflow terms in the Brown and Caldwell model in which MODFLOW drain cells were used to represent groundwater discharge and the evaporation package was used to represent evaporation from Little Lake. The principal items of interest in the Little Lake area are groundwater elevation near the lake, which impacts lake level and discharge, and the amount of groundwater flow available for discharge to springs and transpiration by wet land plants. The MODFLOW evaporation package varies the estimated evaporation rate depending

on the calculated depth to groundwater, which is not currently an issue in this area. The MODFLOW drain package stops calculating flow to the drain when the local groundwater elevation drops below the base of the drain. It is anticipated that groundwater will continue to discharge to Indian Wells Valley at a reduced rate, even if pumping draws groundwater levels down below the level of Little Lake at some point in the future; thus the MODFLOW drain package does not adequately represent possible worst case conditions in the area. Use of MODFLOW GHB cells in this area better represents hydrogeologic conditions and allows both groundwater elevation and discharge rate to be easily monitored during simulations.

C2-3.4 Initial Aquifer Parameters

Aquifer horizontal hydraulic conductivity for the revised model was initially specified with the distribution developed by Brown and Caldwell which ranged from values of 0.28 to 100 ft/day in layers 1 and 2, 0.03 to 2.8 ft/day in layer 3, and 0.28 ft/day in layer 4. Confined aquifer storativity was initially specified as 2×10^{-6}/ft based on the storage coefficient of 0.001 estimated from the 2003 pumping test (GeoTrans, 2003) and an average effective aquifer thickness of 600 ft. Layer 1 specific yield was initially specified as 10 % as specified in the original model. Aquifer vertical hydraulic conductivities were initially specified as the same value as horizontal hydraulic conductivity except near the Hay Ranch where the vertical hydraulic conductivity was reduced to 1 ft/day to be more consistent with the lower vertical hydraulic conductivity indicated by the November/December 2007 pumping test results.

C2-3.5 Model Recalibration

Calibration of the numerical model of groundwater flow conditions in Rose Valley, was conducted in an iterative process which consisted of attempting to match groundwater level drawdown observed during the 2007 pumping test, which was mainly parameters local to the Hay Ranch, then matching model parameters were adjusted across the entire model domain to better fit groundwater inflow/outflow calculations and groundwater elevations measured prior to the pumping test. This process was repeated until both the steady-state model fit the November 2007 groundwater elevation data and the transient version of the model fit the pumping test data.

C2-3.5.1 Calibration to 2007 Pumping Test Data

Time-water level measurements from the Hay Ranch North and the Coso Ranch North wells were used to calibrate the revised numerical model. Boundary groundwater discharge inflow and outflow rates were fixed for this evaluation. A model simulation of the Hay Ranch South well pumping at a rate of 1,925 gpm for 14 days was developed with monitoring points at the Hay Ranch North and Coso Ranch North well locations and other locations in Rose Valley. Then horizontal and vertical hydraulic conductivity, confined aquifer storativity, and unconfined aquifer specific yield were adjusted until a best fit was obtained between observed and model predicted groundwater level drawdown. Plots of predicted versus observed groundwater level drawdown versus time for the Hay Ranch North and Coso Ranch North wells are shown on **Figure C2-14**. A good fit was obtained to the Hay Ranch North well data; the observed water level response of the Coso Ranch North well was complicated by unmetered wells pumping in the area and barometric pressure induced water fluctuations, neither of which are readily reproduced in the numerical model so the model fit to these data was more difficult to assess.

C2-3.5.2 Steady-State Model Recalibration

After developing preliminary, revised estimates of aquifer hydraulic parameters by calibrating to pumping test data, groundwater elevations were simulated and compared to observed elevations. Then the steady-state model was further recalibrated to improve the match between the observed groundwater elevation distribution throughout Rose Valley and estimated groundwater inflow/outflow components. During the model calibration process, mountain front recharge rates and constant head boundary elevations remained unchanged. Hydraulic conductivity and general head boundary cell conductance were adjusted until a reasonable match was obtained between observed and predicted groundwater elevations and groundwater flow component targets. Groundwater flow rate targets consisted of: a total groundwater budget (inflow and outflow) of approximately 5,000 acre-ft/yr; with approximately 800 acre-ft/yr for inflow from Owens Valley, and no more than 4,200 acre-ft/yr discharged to the Little Lake Gap. Groundwater elevation targets were developed from data presented in **Table C2-1**.

C2-3.5.3 Calibrated Model Parameters

Aquifer storage terms were estimated from the pumping test calibration. Final values of 7 x 10^{-7}/ft were identified for confined aquifer storativity (applicable to layers 2, 3, and 4) and 3 % for specific yield (applicable to layer 1 only) based on calibration to the pumping test data.

The distribution of calibrated model hydraulic conductivity values are illustrated on **Figures C2-8** through **C2-11** for layers 1 through 4, respectively. Horizontal hydraulic conductivity ranged from values of 0.08 to 200 ft/day in layers 1 and 2, 0.03 to 2.8 ft/day in layer 3, and a constant value of 0.28 ft/day in layer 4. The main changes in the hydraulic conductivity distribution developed for the recalibrated model were: 1) lower vertical hydraulic conductivity in the alluvial deposits near the central part of Rose Valley; 2) lower horizontal hydraulic conductivity in the area south of the Red Hill cinder cone where volcanic deposits interfinger with alluvial sands; and, 3) slightly higher horizontal hydraulic conductivities in the alluvial deposits near Little Lake and to the north. The horizontal hydraulic conductivity of alluvial deposits near the Hay Ranch, represented by layers 1 and 2, was unchanged from the 2006 model. A lower vertical hydraulic conductivity value of 0.019 ft/day (compared to 2.4 ft/day previously) was used in this area based on the results of the 2007 pumping test.

C2-3.5.4 Calibrated Model Accuracy

The accuracy of the model calibration efforts was evaluated by comparison of observed and simulated groundwater elevations; and by comparison of conceptual and simulated groundwater budgets. **Figure C2-12** shows a comparison of predicted groundwater elevation contours versus groundwater elevations observed in November 2007. **Figure C2-13** shows a plot of predicted versus observed groundwater elevation at the eleven target locations for the steady state model. A perfect match is indicated by the dashed line on **Figure C2-13**.

The model simulated groundwater elevations scatter closely around the ideal calibration line throughout the central and southern portions of Rose Valley but are lower than the observed values in the Cal-Pumice and LADWP wells at the north end of the valley. Excluding the values for the Cal-Pumice and LADWP wells, the residual and absolute mean errors were –1 and +2.2 ft which are less than 1 % of the observed range in groundwater elevations along the length of Rose Valley. Including the Cal-Pumice and

LADWP wells, the residual and absolute mean errors are still less than 5% of the observed range in groundwater elevations. The discrepancy between predicted and observed groundwater elevations at the north end of the valley points to a shortcoming in the data available for developing the model, and, consequently, a shortcoming in the model. As noted previously, groundwater elevations are expected to vary seasonally near Haiwee Reservoir but have not been measured since Bauer's work in 1998. Data from 1998 monitoring were used to develop the boundary conditions for the north end of the model.

Figure C2-14 presents a comparison of the simulated versus observed groundwater level drawdown in the Hay Ranch North and Coso Ranch North wells during the November/December 2007 pumping test. The model simulates the drawdown observed in the Hay Ranch North well reasonably well with an average error of 0.2 ft but does less well with the Coso Ranch North well. The model predicted no more than 0.1 ft of drawdown in the Coso Ranch North well while the groundwater level may have drawn down as much as 0.25 ft during the pumping test. The model predicts nearly 0.3 ft of drawdown in the Cal-Pumice well which cannot be confirmed because of a pre-existing falling water level trend in that well. The model predicts that less than 0.01 ft of drawdown develops in the Lego, 18-36, or Little Lake Ranch North wells, consistent with field observations.

The accuracy of the calibration was also evaluated by comparing the conceptual and simulated water budgets. Previous estimates of the groundwater underflow into Rose Valley from Owens Valley/Haiwee Reservoir ranged from 600 to 788 acre-ft/yr. The recalibrated model estimated the groundwater inflow from the north to be 890 acre-ft/yr. Brown and Caldwell estimated the groundwater underflow to Indian Wells Valley from southeastern Rose Valley to be as much as 2,050 acre-ft/yr. The recalibrated model estimated the groundwater underflow by this pathway as 850 acre-ft/yr. The groundwater outflow from the Little Lake area including evaporation losses has been estimated to be between 2,900 and 3,800 acre-ft/yr. The recalibrated model estimated the groundwater outflow from the Little Lake area to be 4,200 acre-ft/yr but that total included transpiration losses from wetland plants that were not considered in previous estimates.

C2-3.5.5 Model Limitations/Data Gaps

The process of reviewing hydrogeologic data for the site and recalibrating the model identified several data gaps and resulting limitations of the numerical groundwater flow model developed for Rose Valley. These include:

- Lack of recent seasonal groundwater elevation data north of Rose Valley adjacent to the southern Haiwee Reservoir. As discussed in Section C2-3.5.4, the model underpredicted steady state groundwater elevations in the Cal-Pumice and LADWP wells by 16 and 105 ft, respectively while matching groundwater elevations in wells in the remainder of the valley to within 1 to 5 ft. The model also represents groundwater elevation as fixed at the north end of the model grid which is inconsistent with monitoring data for the LADWP wells which indicated groundwater level fluctuations of up to 7 ft seasonally. The cause of these fluctuations and the discrepancy between predicted and observed groundwater elevations in this area are not well understood and need further investigation. However, because the model matches groundwater elevation observations in central and south Rose Valley reasonably well, it is useful for prediction of pumping impacts at the south end of the valley.

- Lack of transmissivity or storativity data outside the Hay Ranch area. It should be noted that estimated aquifer hydraulic parameters were evaluated by conducting a pumping test at the Hay Ranch. As noted previously, drawdown was only observed near the Hay Ranch, so estimates of aquifer parameters elsewhere in Rose Valley are heavily dependent on assumptions and parameters built into the numerical model.
- Lack of recent seasonal flow measurements or water level measurements on the Little Lake Ranch property. The most recent data for Little Lake water level and groundwater and spring discharges at the Little Lake Ranch date to 1998. While groundwater elevations in Rose Valley appear to be similar or higher than Bauer observed in 1998, suggesting the flow measurements are still applicable, future monitoring programs should include the hydrogeologic features at Little Lake.

C2-4 Analysis of Groundwater Development Scenarios

This section discusses the evaluation of several groundwater development scenarios. For these scenarios, the numerical groundwater flow model developed for Rose Valley was run in transient mode, using the calibrated aquifer hydraulic conductivity and boundary cell elevation, conductance, and flow values identified in Section C2-3.5.3. An aquifer storage coefficient value of 7×10^{-7}/ft was used for model layers 2, 3, and 4.

The model calibration to the 2007 pumping test data yielded an estimated specific yield for the alluvial aquifer of 3 %. This value is quite low for typical sand and gravel aquifers such as occur in Rose Valley and is believed to underestimate the specific yield value applicable to multi-year pumping. Specific yield values estimated from pumping tests frequently underestimate the actual drainable porosity of the aquifer (see Neuman, 1975; Zhan and Zlotnik, 2002). Published values of specific yield (Johnson, 1967; Morris and Johnson, 1967) range from 2 % for clay to 35 % for well-graded gravels as tabulated in Table C2-5. Groundwater-yielding sediments encountered in Rose Valley consist primarily of sand and gravel interbedded with clays; most of the groundwater will come from the more readily drainable sand and gravel horizons. Because specific yield could not be determined from the pumping test data, a range of values corresponding to high, medium, and low values of 30, 20 and 10 % were used in the project development impact analyses discussed below.

C2-4.1 Full Project Development

Full project development consists of pumping the two Hay Ranch wells at a combined total extraction rate of 4,839 acre-ft/yr with pumping evenly divided between the two wells. For this evaluation, 180 year transient simulations were performed with groundwater table drawdown and groundwater discharge rates reported at regular intervals to evaluate aquifer conditions after the specified 30 years of continuous pumping. All aquifer parameters were maintained as described for the calibrated model with the exception that specific yield in the uppermost model layer was set to values of 10%, 20% or 30% for individual model runs to assess sensitivity to this parameter.

Table C2-5: Values of Specific Yield from Johnson, 1967

Soil Type	Minimum	Average	Maximum
Clay	--	2	5
Sandy clay (mud)	3	7	12
Silt	3	18	19
Fine sand	10	21	28
Medium sand	15	26	32
Coarse sand	20	27	35
Gravelly sand	20	25	35
Fine gravel	21	25	35
Medium gravel	13	23	26
Coarse gravel	12	22	26
Volcanic Tuff	--	21	--
Till, predominantly sand	--	16	--
Till, predominantly gravel	--	16	--

C2-4.1.1 Evaluation of Potential Drawdown Impacts

Numerical values for initial groundwater elevation throughout the active portion of the model domain were established by running a steady state simulation with aquifer parameters and boundary conditions set as described in preceding sections with no pumping whatsoever at Hay Ranch. A transient version of the calibrated numerical model, with the same aquifer parameters and boundary conditions as the steady state model, was used to predict aquifer response to various rates and durations of pumping at Hay Ranch. Drawdown at selected observation points was calculated by having MODFLOW import the final groundwater elevations from the steady state model and subtract predicted groundwater elevations at these observations points from the output of the transient model simulation run. These values were then saved as a series of time-drawdown predictions at selected monitoring points.

C2-4.1.2 Evaluation of Potential Groundwater Flow Impacts

Numerical values for initial groundwater flow rates in various portions of the model domain were established by running a steady state simulation with aquifer parameters and boundary conditions set as described in preceding sections with no pumping whatsoever at Hay Ranch. A transient version of the calibrated numerical model, with the same aquifer parameters and boundary conditions as the steady state model, was used to predict aquifer response to various rates and durations of pumping at Hay Ranch. Changes in groundwater flow rates in various portions of the model were then evaluated by comparing the groundwater flow rates predicted in the steady state model with no Hay Ranch pumping to the groundwater flow rates predicted in the transient

model with specified rates and duration of pumping at the Hay Ranch wells. The Groundwater Vistas groundwater Mass Balance Export function to extract groundwater flow rates from selected portions of the model domain in the steady state and transient model simulations, respectively.

C2-4.2 Cumulative Effects Analysis

The Cumulative Effects Analysis consisted of developing and running a transient model simulation scenario in which the Hay Ranch wells were pumped at the full project development rate of 4,839 acre-ft/yr plus pumping was simulated at the LADWP wells at a rate totaling 900 acre-ft/yr using the MODFLOW well package. Initial attempts at performing this analysis failed because the model cell in which LADWP well V816 is located went dry before the end of the simulation, terminating groundwater extraction at that location.

The extraction rate from the LADWP property was then dispersed between several well nodes and eventually reduced until a stable simulation run could be conducted. That occurred when extraction of approximately 770 acre-ft/yr was distributed between three pumping nodes. Potential impacts to groundwater elevation and flow rates were then performed as described in Sections C2-4.1.1 and C2-4.1.2, respectively.

C2-5 Analysis of Mitigation Measures

Potential measures to mitigate possible impacts to groundwater resources of Rose Valley caused by implementation of the full development project rate of 4,839 acre-ft/yr extraction from the Hay Ranch wells were evaluated using the numerical groundwater flow model. The mitigation measures evaluated consisted of:

- Reducing Hay Ranch pumping rates below the full project development rate of 4,839 acre-feet per year;
- Reducing Hay Ranch pumping duration from the full project duration of 30 years; and,
- Augmenting the water supply to Little Lake by extracting groundwater on the Little Lake Ranch property and pumping that water into the lake.

Techniques for evaluating potential groundwater table drawdown and changes to groundwater flow rates used in the evaluation of potential mitigation measures are the same as those described in Section C2-4 and are not discussed further here.

C2-5.1 Little Lake Water Supply Augmentation

The calibrated numerical groundwater flow model was used to evaluate the potential for augmenting the water supply available to maintain the water level in Little Lake. Prolonged pumping of the Hay Ranch wells could result in groundwater table drawdown near Little Lake that could reduce groundwater inflow to the lake and consequently reduce lake levels. A potential mitigation measure to restore or maintain lake levels would involve pumping groundwater from an existing or new well on the Little Lake Ranch property and pumping the water into Little Lake. Augmentation by pumping groundwater from one of the Little Lake Ranch wells into the lake reportedly has been conducted in the past; however, details of previous augmentation efforts were not available for review. Adding water to the lake would provide water closer to the ground surface for irrigation needs and maintenance of phreatophyte plant communities.

Augmentation might only be needed during the summer months when phreatophyte plants actively grow and transpire soil moisture.

Augmentation was evaluated by specifying groundwater extraction from a well node located on the Little Lake Ranch property and injection of an equal amount of water via a well node located within the footprint of Little Lake. The amount of groundwater needed to augment lake levels is difficult to estimate at this time because there are not much data on the hydrologic features at the lake. A simulation in which groundwater was extracted from the Little Lake Ranch House well at an annualized rate of 740 acre-ft/yr (450 gpm) and reinjected into Little Lake was conducted. The augmentation simulation assumed that 1) production at the Hay Ranch would be reduced to 2,424 acre-ft/yr (1,500 gpm) beginning in the 20th year after project startup, and, 2) that extraction from the Little Lake Ranch House well coupled with injection into Little Lake would start at the same time. Results of the augmentation simulation indicated that water could be added to Little Lake to maintain surface water flows. However, groundwater drawdown on the property could be increased over and above the amount induced by pumping the wells at Hay Ranch as a result of the groundwater extraction. Because most of the groundwater diverted into the lake ultimately infiltrates back into the ground on the property, the increased drawdown is expected to be small. For this augmentation scenario, the model predicted an increase in drawdown of approximately 0.1 ft below Little Lake as a result of the pumping on the property and increased approximately 1 to 2 ft around the Little Lake Ranch House well.

Analysis of the capacity of one or more of the wells on the Little Lake Ranch property would need to be completed early in the project, preferably during the baseline monitoring period, to establish the viability of this mitigation option. An analysis of the interaction between groundwater and lake levels and discharge rates would also need to be completed during the baseline monitoring period to evaluate the potential amount of water needed, should an augmentation scheme be employed later in the life of the project.

C2-6 References

Bauer, C.M., 2002, “The Hydrogeology of Rose Valley and Little Lake Ranch, Inyo County, California”, Master’s Thesis, California State University, Bakersfield, April 2002.

Brown and Caldwell, 2006, “Rose Valley Groundwater Model”, Coso Operating Company, LLC, Rose Valley, California, April 10, 2006.

Bloyd, R.M. Jr., and S.G. Robson, 1971, “Mathematical Ground-water model of the Indian Wells Valley, California”, U.S. Geological Survey Open-File report 72-41.

CWRCB, 1993, “Draft Environmental Impact Report for the Review of

Mono Basin Water Rights of the City of Los Angeles”, California State Water Resources Control Board, Division of Water Rights, 901 P Street, 3rd Floor, Sacramento, CA 95814

Prepared by: Jones & Stokes Associates, Inc., 2600 V Street, Suite 100, Sacramento, CA., May 1993.

Danskin, W.R., 1998, “Evaluation of the Hydrologic System and Selected Water-Management Alternatives in the Owens Valley, California”, U.S. Geological Survey Water-Supply Paper 2370, Chapter H.

Environmental Simulations, 2007, Guide to Using Groundwater Vistas, Version 5.

Geologica, 2007, "*Draft Hay Ranch Pumping Test Work Plan Conditional Use Permit Hay Ranch Water Extraction and Delivery Project-Hydrology Review*", November 6, 2007.

GeoTrans, 2003, "*Results of Aquifer Tests, Hay Ranch Production Wells, Rose Valley, Coso Junction, California",* (report), prepared for Coso Operating Company, LLC, October 13, 2003.

GeoTrans, 2004, "*Revised Hydrogeological Conceptual Model for the Rose Valley*", prepared for Coso Operating Company, June 30, 2004.

Hay Ranch, 1971, Water Well Drillers Reports, Hay Ranch Irrigation Wells #1 and #2.

Johnson, A.I. 1967. Specific yield — compilation of specific yields for various materials. U.S. Geological Survey Water Supply Paper 1662-D, 74 p.

LADPS, 1916, "Complete Report on Construction of the Los Angeles Aqueduct, with Introductory Historical Sketch", Department of Public Service of the City of Los Angeles, 1916.

LADWP, 2008, Los Angeles Aqueduct Condition Reports, accessed at http://www.ladwp.com/ladwp/cms/ladwp005341.jsp, Los Angeles Department of Water and Power.

McDonald, M.G. and A.W. Harbaugh, 1988, "A Modular Three-Dimensional Finite-Difference Ground-Water Flow Model", Techniques of Water-Resources Investigations of the United States Geological Survey.

Morris, D.A. and Johnson, A.I., 1967. Summary of hydrologic and physical properties of rock and soil materials as analyzed by the Hydrologic Laboratory of the U.S. Geological Survey 1948-1960. U.S. Geological Survey Water Supply Paper 1839-D, 42 p.

Navy, 2003, *Generalized Lithologic Log of Well 18-28*.

Schaer, D.W., 1981, "A Geologica Summary of the Owens Valley Drilling Project, Owens and Rose Valleys, Inyo County, California", Prepared for the U.S. Department of Energy, Grand Junction Office, Contract No. DE-AC13-76GJ01664, cited in GeoTrans, 2003.

Thompson, D.G., 1929, "The Mohave Desert Region, California, a Geographic, Geologic, and Hydrologic Reconnaissance", U.S.G.S. Water Supply Paper 578.

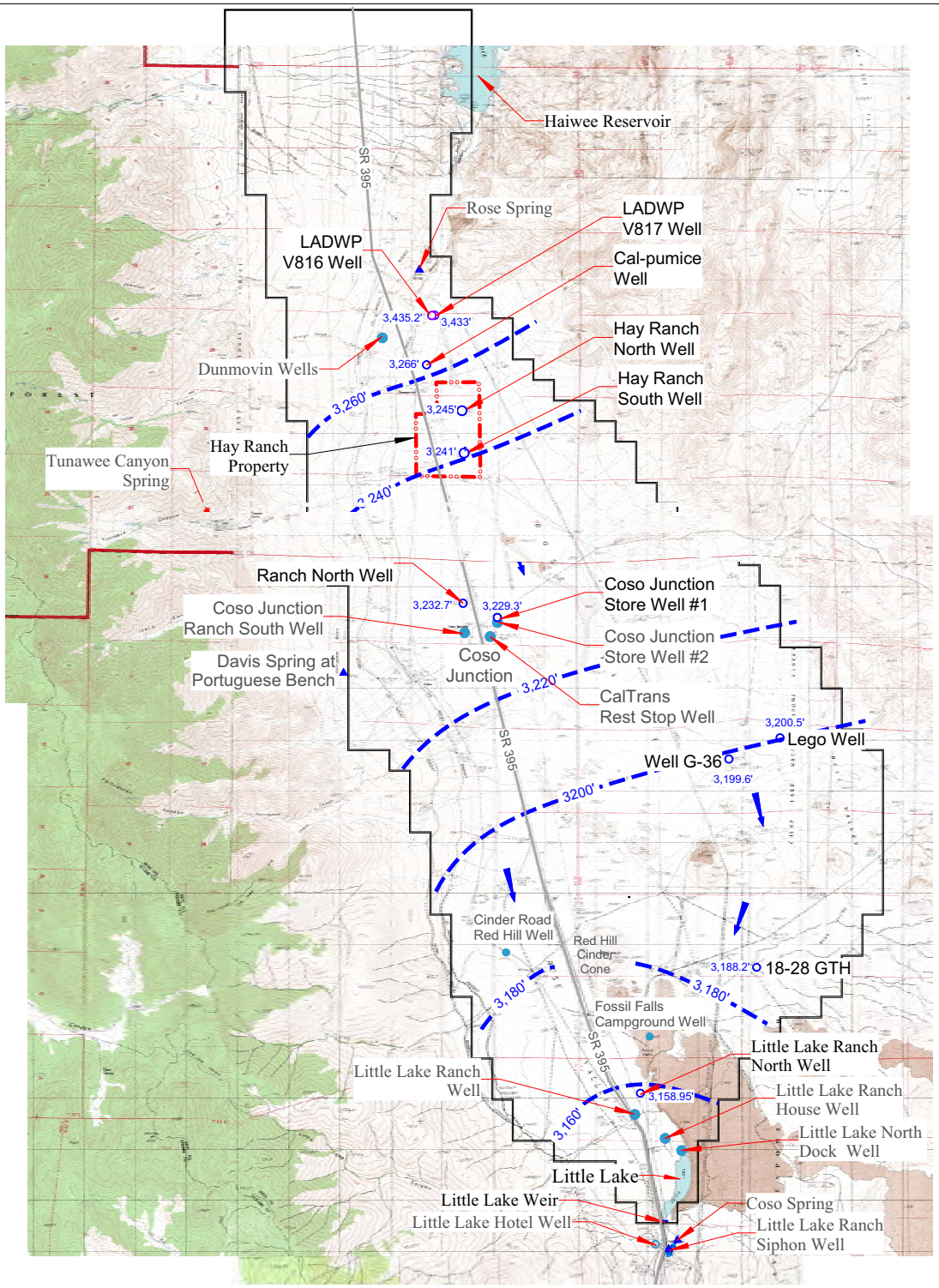
Triad / holme associates, 2007, Well Location and Elevation Survey, Rose Valley, CA., conducted for Cosos Operating Company, November 2007.

ULLR, 2000, Upper Little Lake Ranch, Inc., Habitat Restoration and Improvement Plan as Approved October 14, 2000, April 20, 2001.

Weiss R. B., 1979, "Hydrologic Evaluation for Geothermal development- an Example at COSO Hot springs, California., in Expanding the Geothermal Frontier, Transactions Volume 3, Geothermal Resources Council Annual Meeting, 24-27 September 1979, Reno, Nevada.

Williams, D.V., 2004, "Hydrogeologic and Hydrochemical Framework of Indian Wells Valley, California: Evidence for Interbasin Flow in the Southern Sierra Nevada", Master's Thesis, Colorado School of Mines, Golden, Colorado.

Zhan, H., Zlotnik, V. A., 2002, "An Explanation of Anomalous Specific Yield in Unconfined Aquifers", American Geophysical Union, Fall Meeting 2002, December 2002.



Key

- Well Monitored during Pumping Test
- 3158.95' — Groundwater Elevation, ft AMSL
- 3,160' — Groundwater Elevation Contour, ft
- Groundwater Flow Direction
- Boundary of Numerical Model
- Spring or Siphon Well

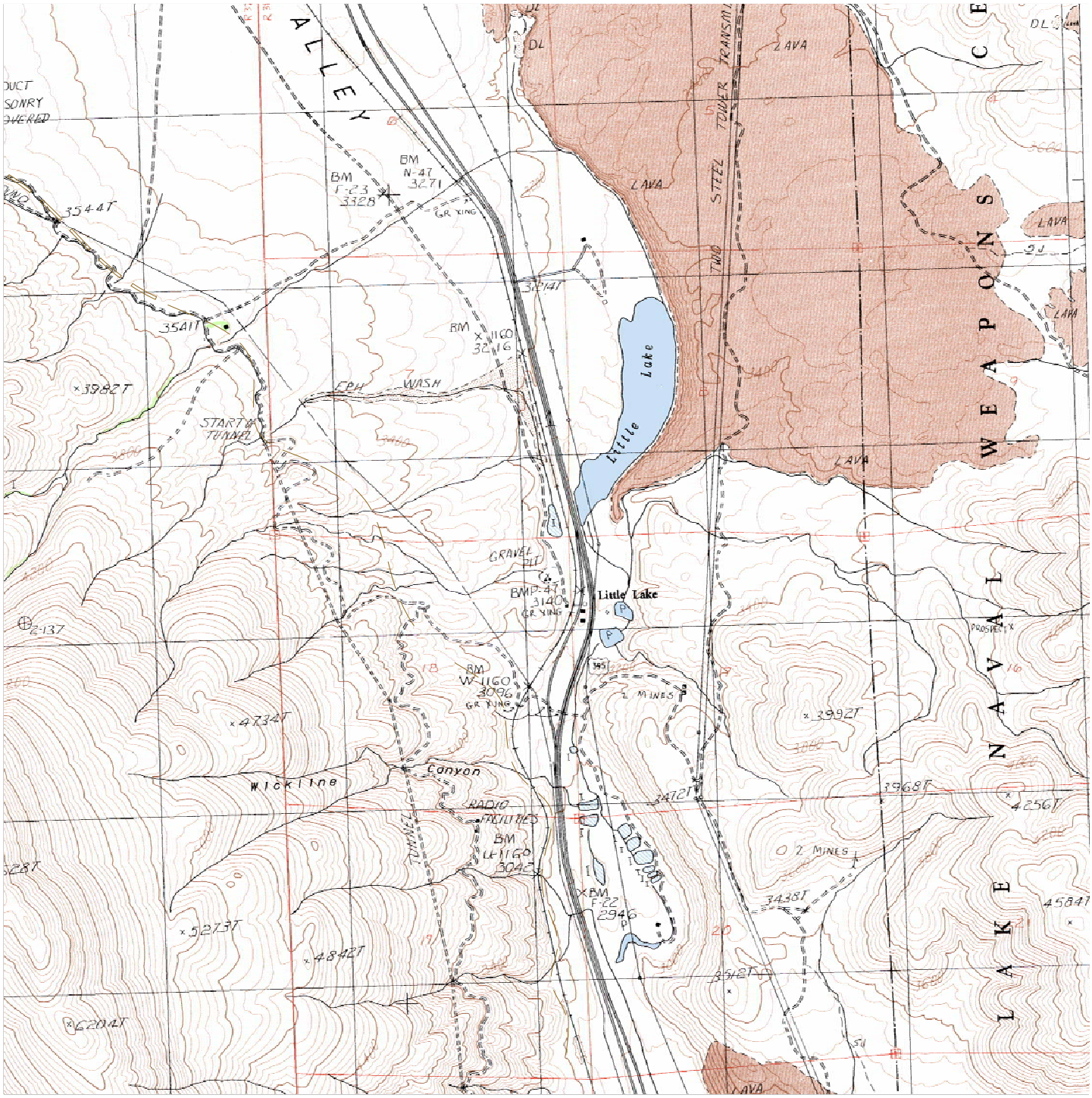
Approximate Scale in miles

0 1 2

N

Study Area Map and Groundwater Elevation Contour Map - November 2007

Figure C2-1



Key

Approximate Scale in miles

0 0.5

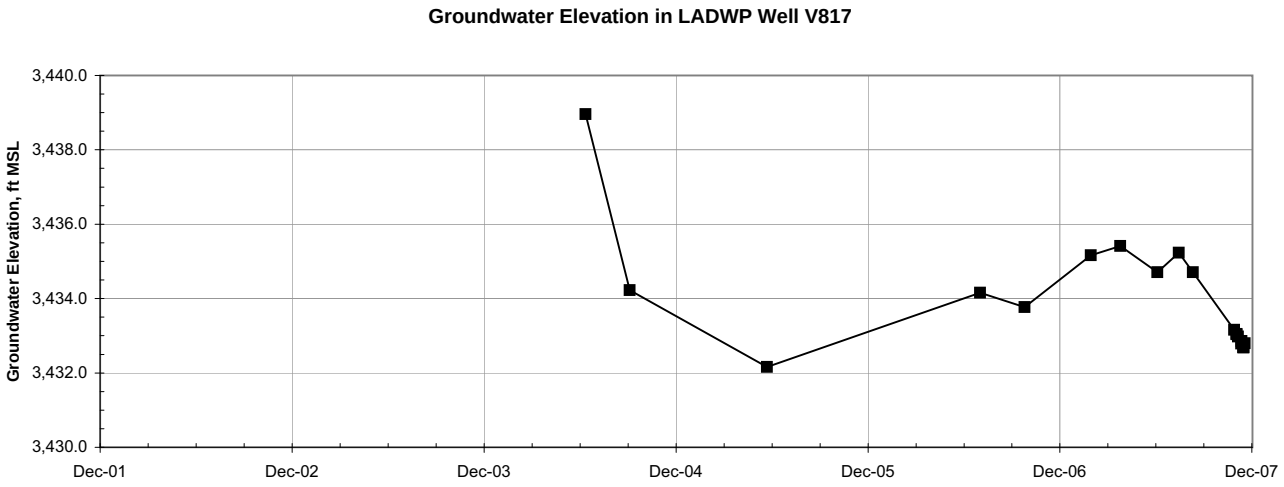
N

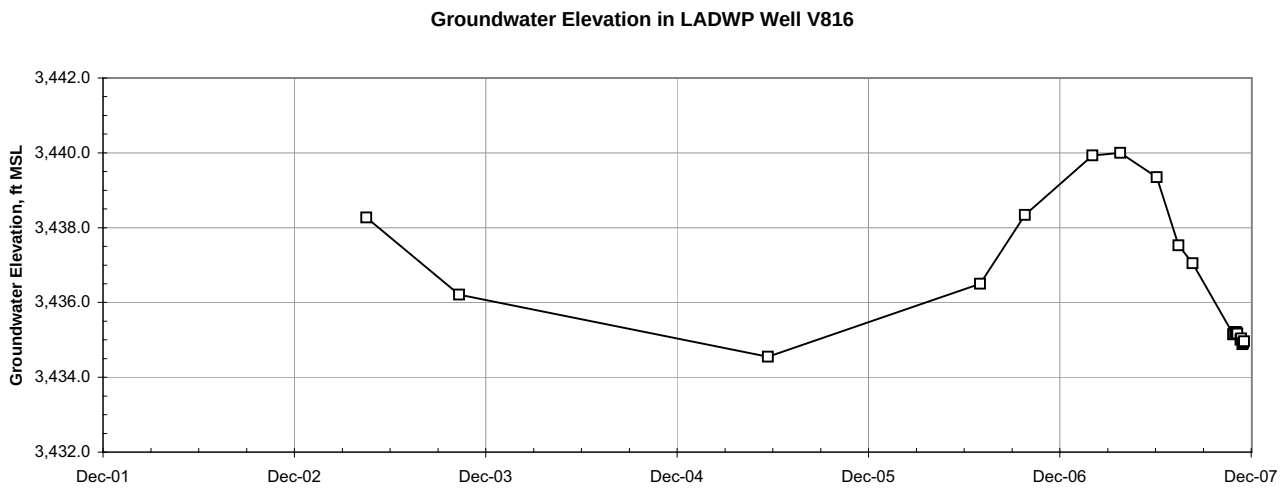
- Spring or Siphon Well
- Pumping Well
- Out-of-Use Well

Hydrologic Features of Little Lake Ranch

Figure C2-2

Figure C2-3
Rose Valley Groundwater Level Hydrographs





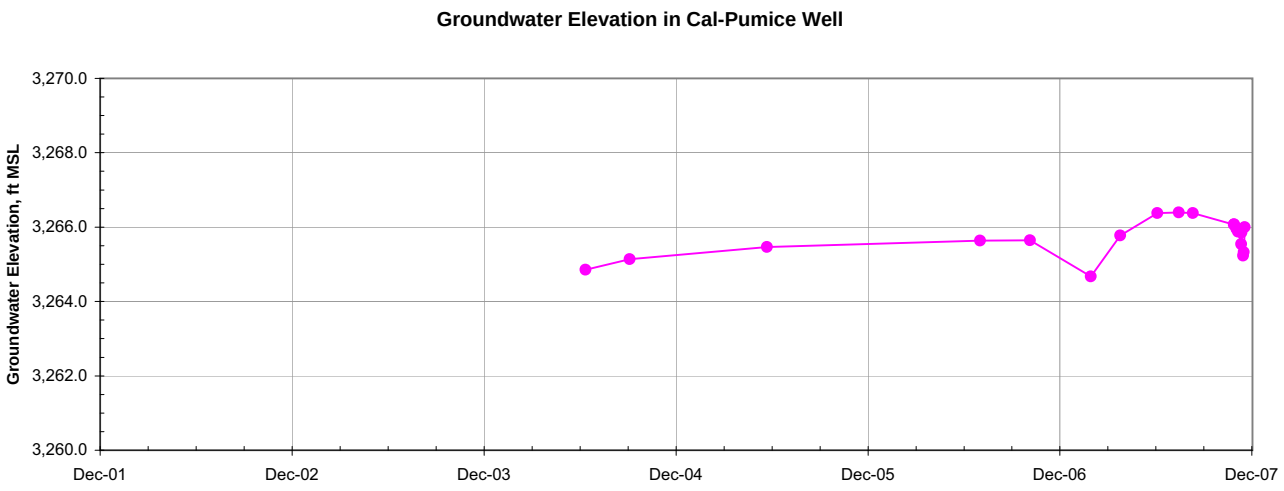
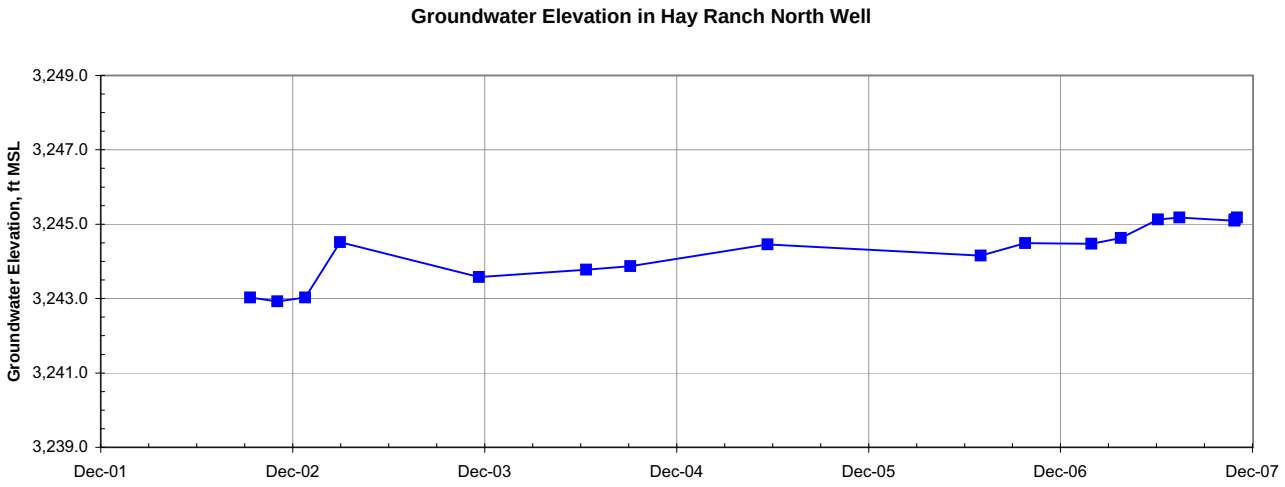
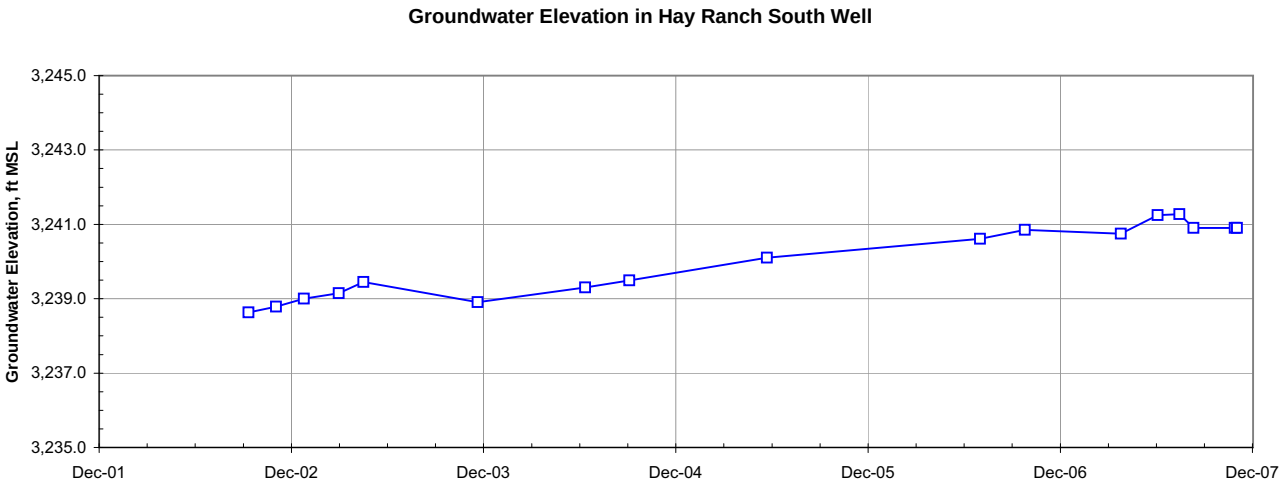


Figure C2-3
Rose Valley Groundwater Level Hydrographs





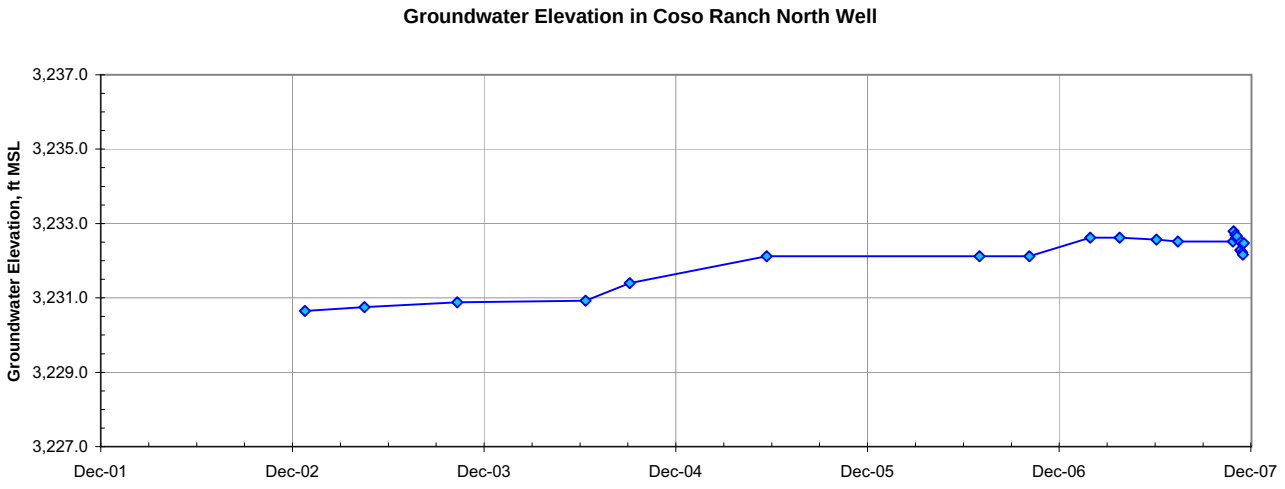
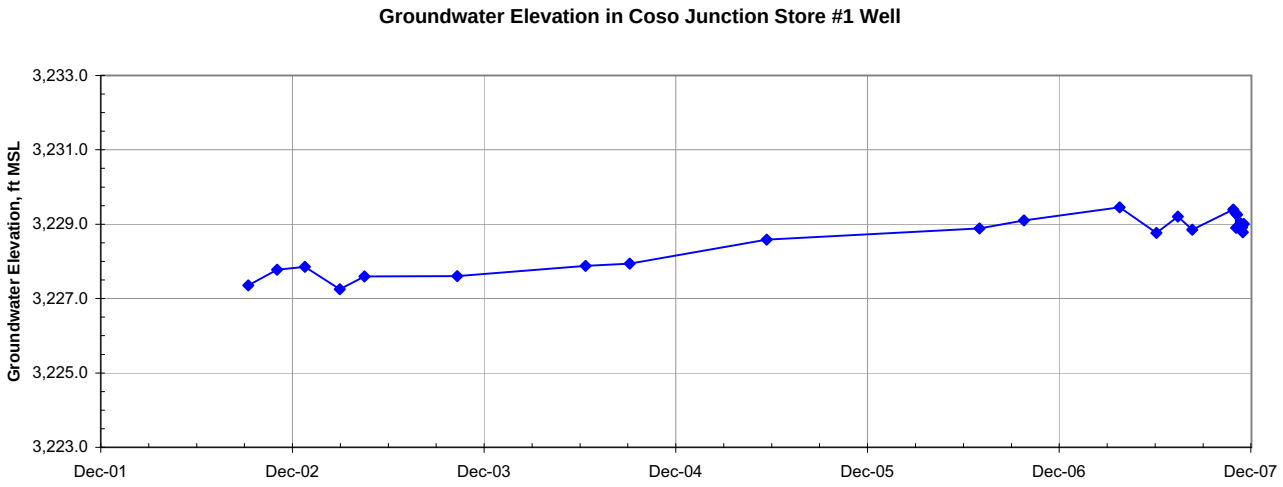
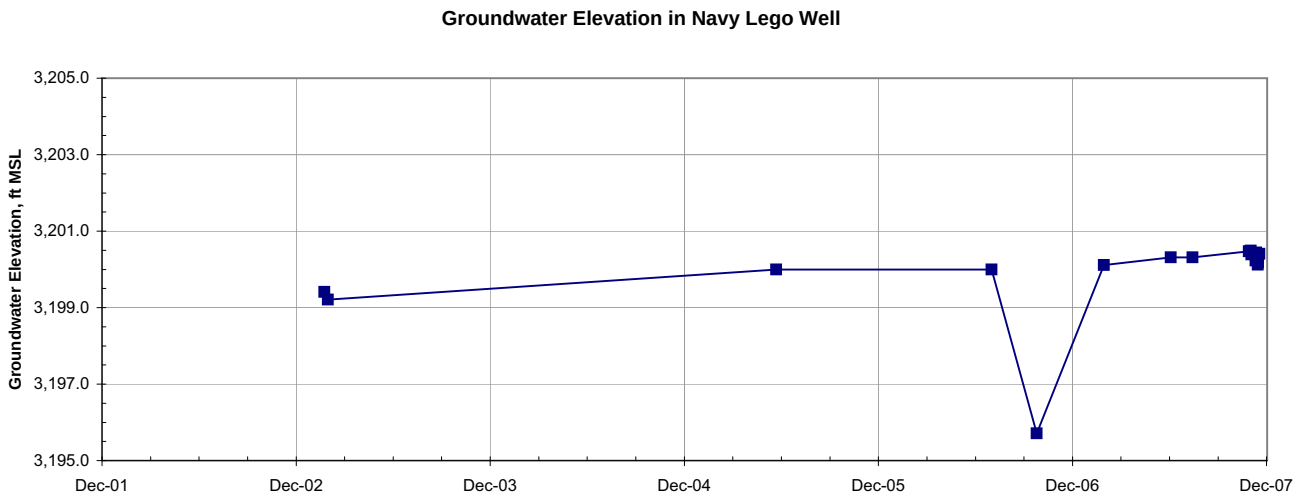


Figure C2-3
Rose Valley Groundwater Level Hydrographs





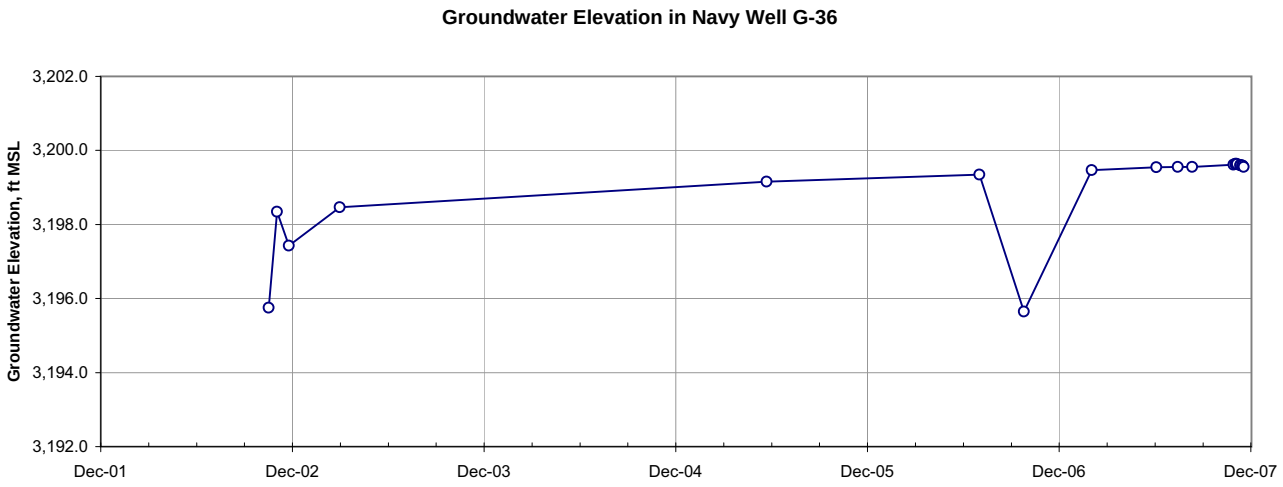
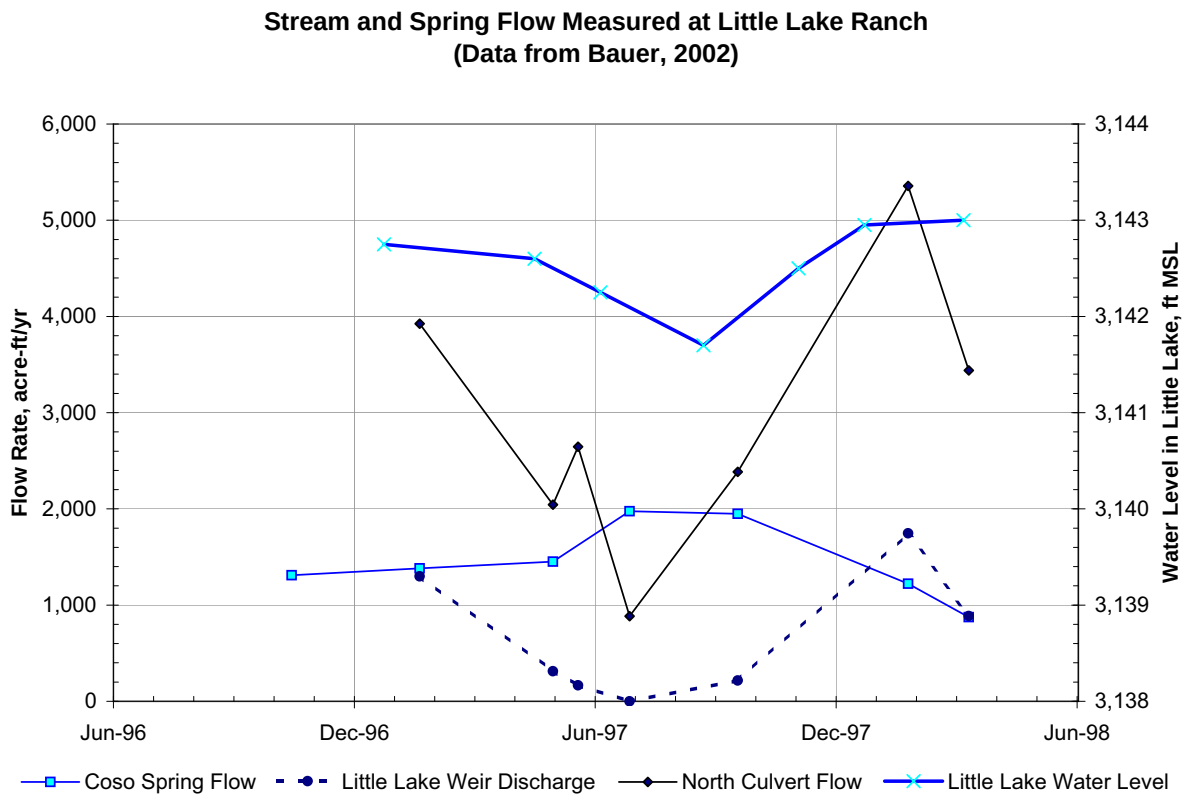
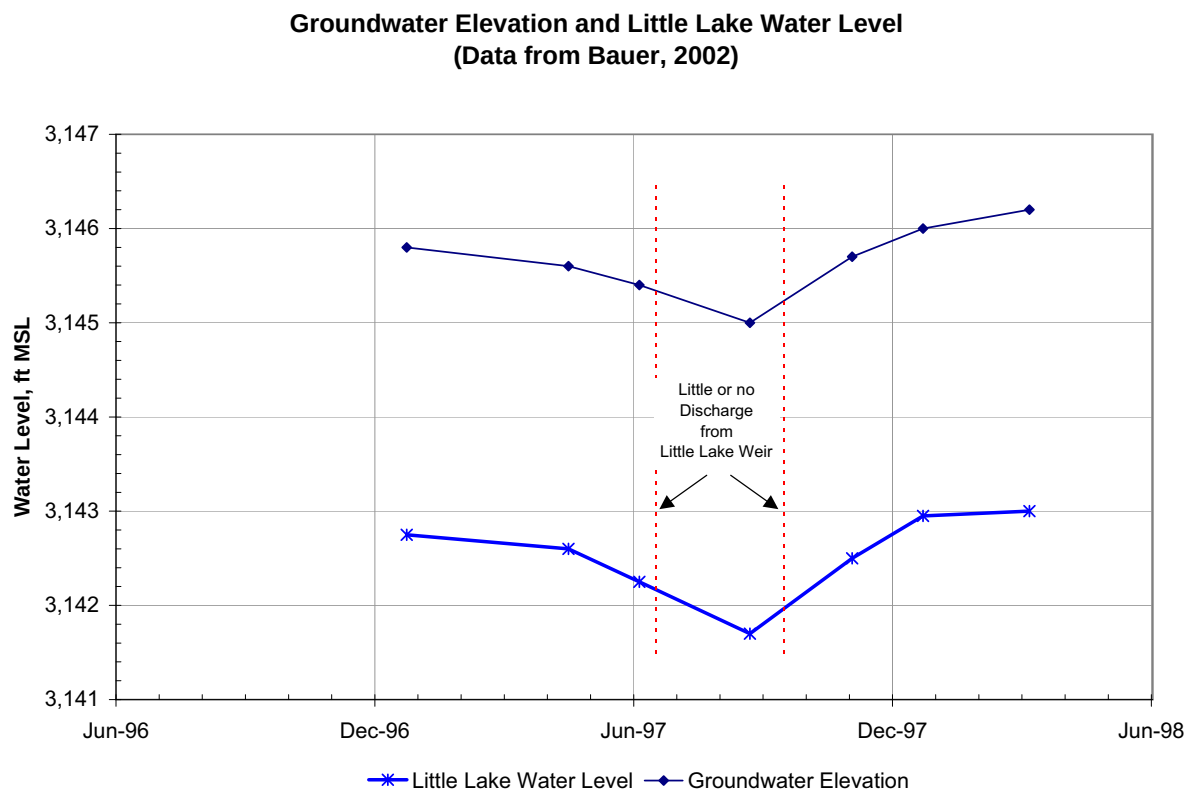
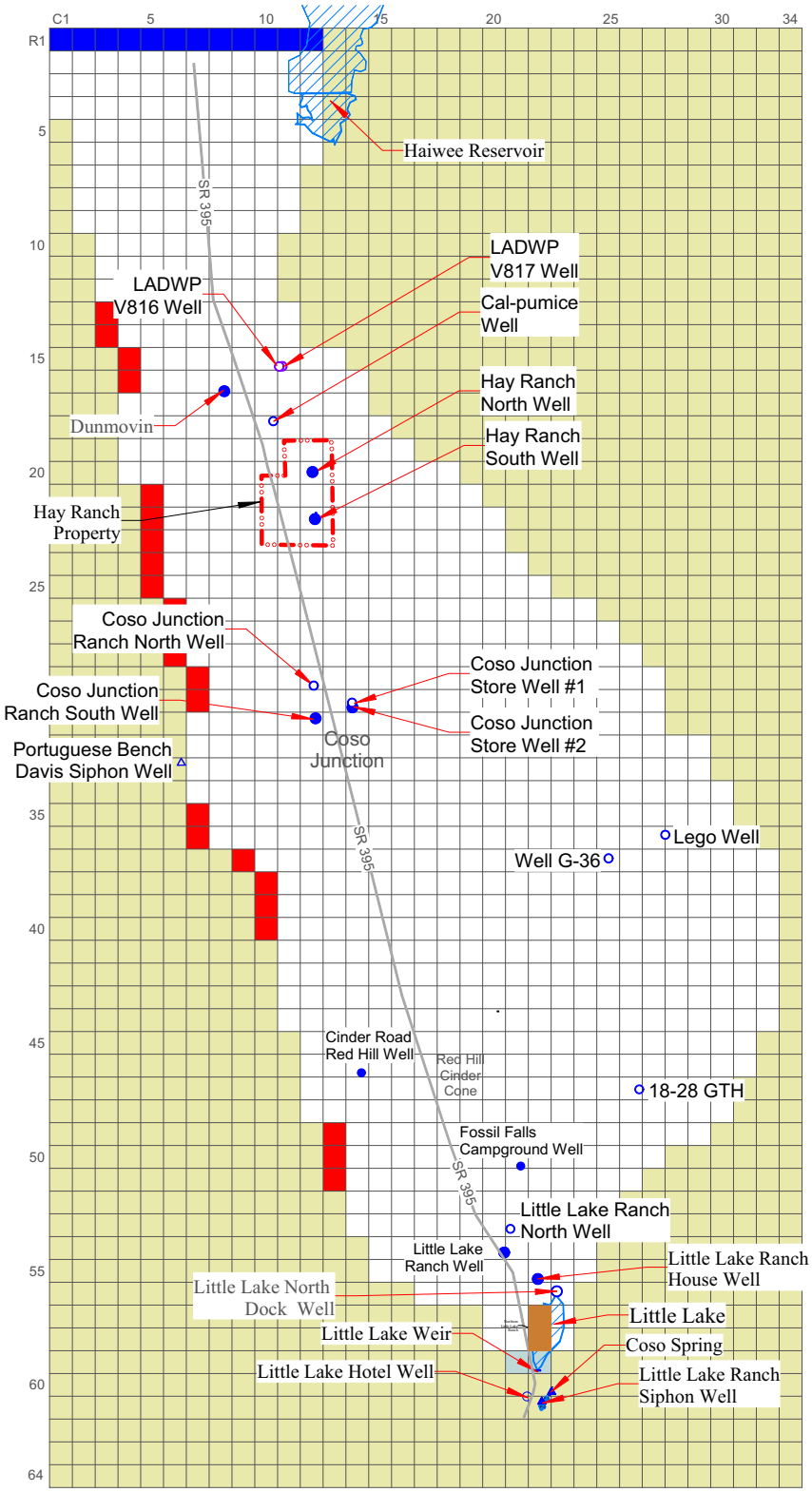


Figure C2-4
Flow and Water Level Measurements at Little Lake







Key

- Spring or Siphon Well
- Pumping Well
- Out-of-Use Well
- Specified Flux Cell
- Constant Head Cell
- General Head Boundary Cell
- No Flow (Inactive) Cell
- Evapotranspiration Cell (Layer 1 only)

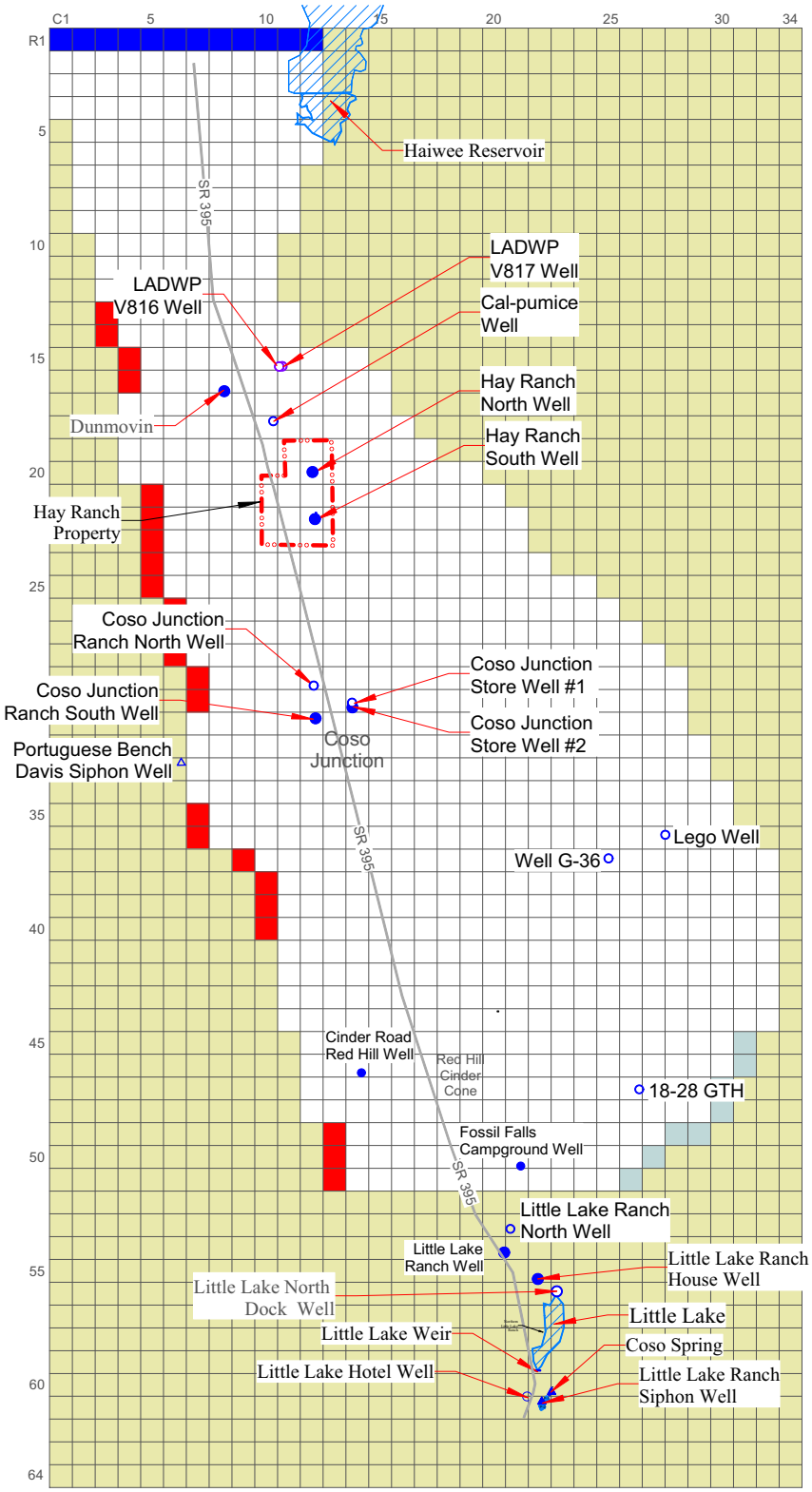
Approximate Scale in miles

0 1 2

N

Model Domain and Boundary Conditions Layers 1 and 2

Figure C2-5



Key

- Spring or Siphon Well
- Pumping Well
- Out-of-Use Well
- Specified Flux Cell
- Constant Head Cell
- General Head Boundary Cell
- No Flow (Inactive) Cell

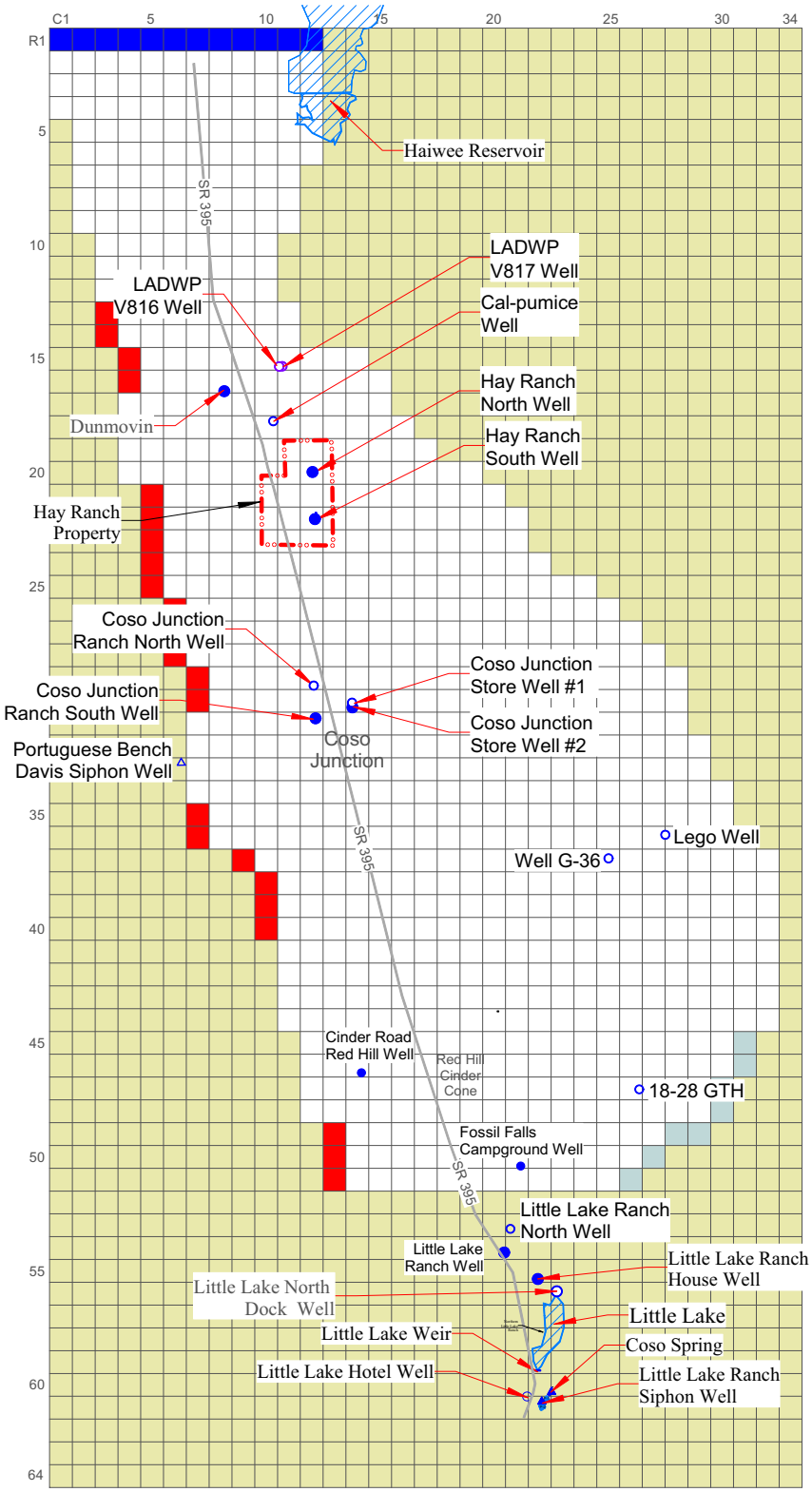
Approximate
Scale in miles

0 1 2

N

Model Domain and Boundary Conditions Layer 3

Figure C2-6



Key

- Spring or Siphon Well
- Pumping Well
- Out-of-Use Well
- Specified Flux Cell
- Constant Head Cell
- General Head Boundary Cell
- No Flow (Inactive) Cell
- Boundary of Active Portion of Numerical Model

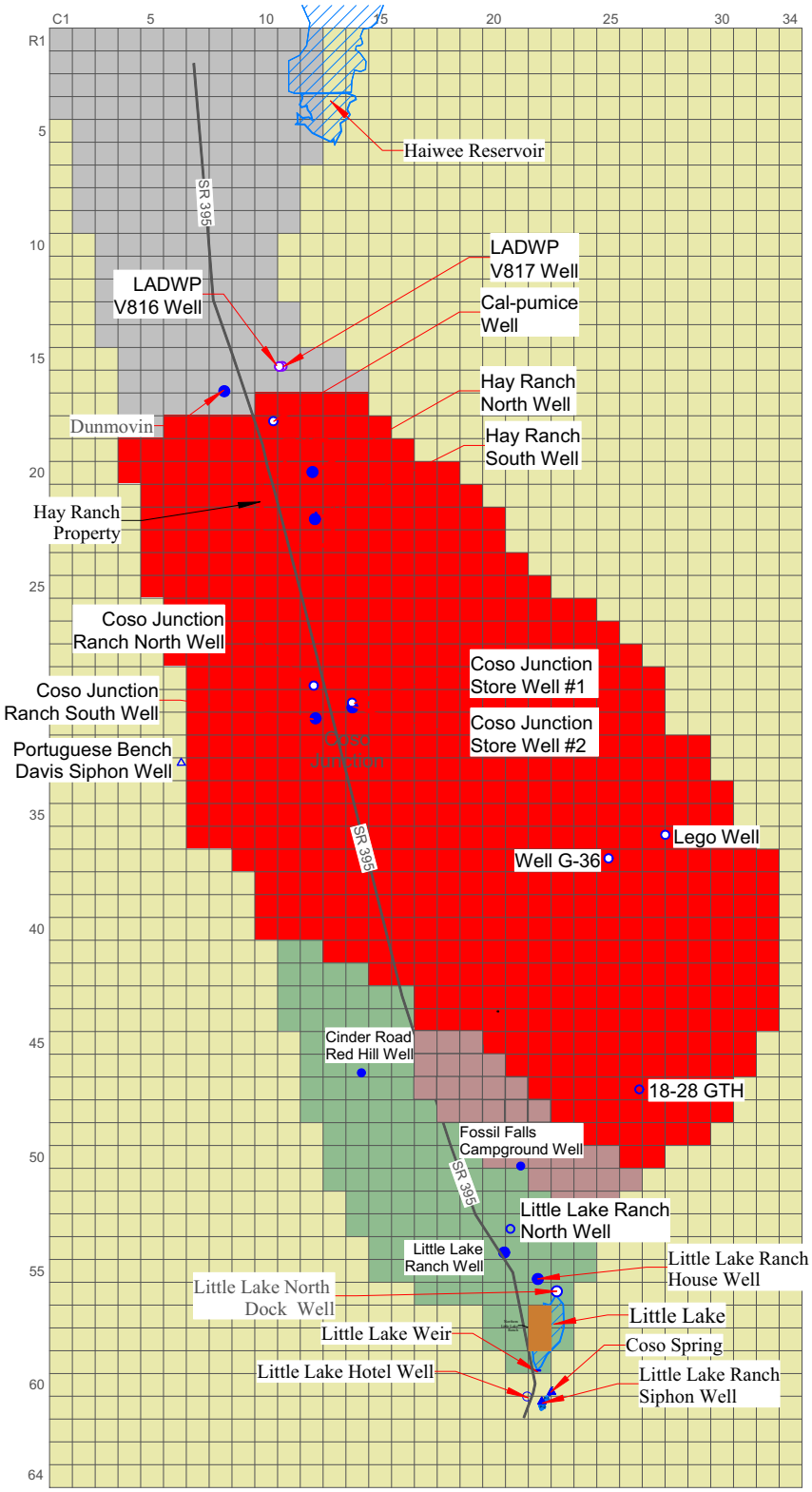
Approximate
Scale in miles

0 1 2

N

Model Domain and Boundary Conditions Layer 4

Figure C2-7



Key

- Spring or Siphon Well
- Pumping Well
- Out-of-Use Well
- No Flow (Inactive) Cell
- Kh = 0.55 ft/day, Kz = 0.055 ft/day
- Kh = 1 ft/day, Kz = 0.1 ft/day
- Kh = 24 ft/day, Kz = 0.019 ft/day
- Kh = 200 ft/day, Kz = 20 ft/day

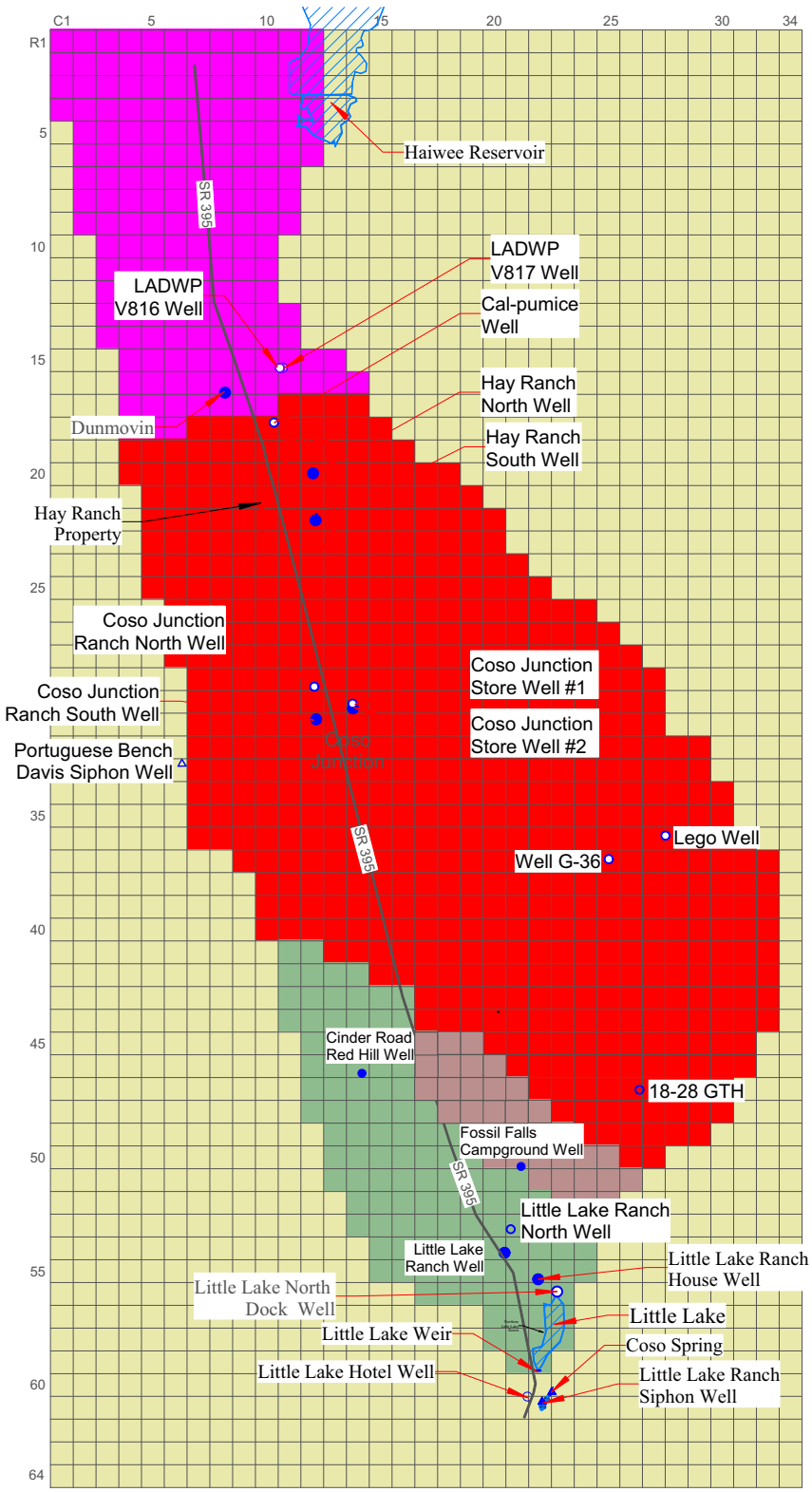
Approximate Scale in miles

0 1 2

N

Hydraulic Conductivity Distribution in Layer 1

Figure C2-8



Key

- Spring or Siphon Well
- Pumping Well
- Out-of-Use Well
- No Flow (Inactive) Cell
- Kh = 0.08 ft/day, Kz = 0.08 ft/day
- Kh = 1 ft/day, Kz = 0.1 ft/day
- Kh = 24 ft/day, Kz = 0.019 ft/day
- Kh = 200 ft/day, Kz = 20 ft/day

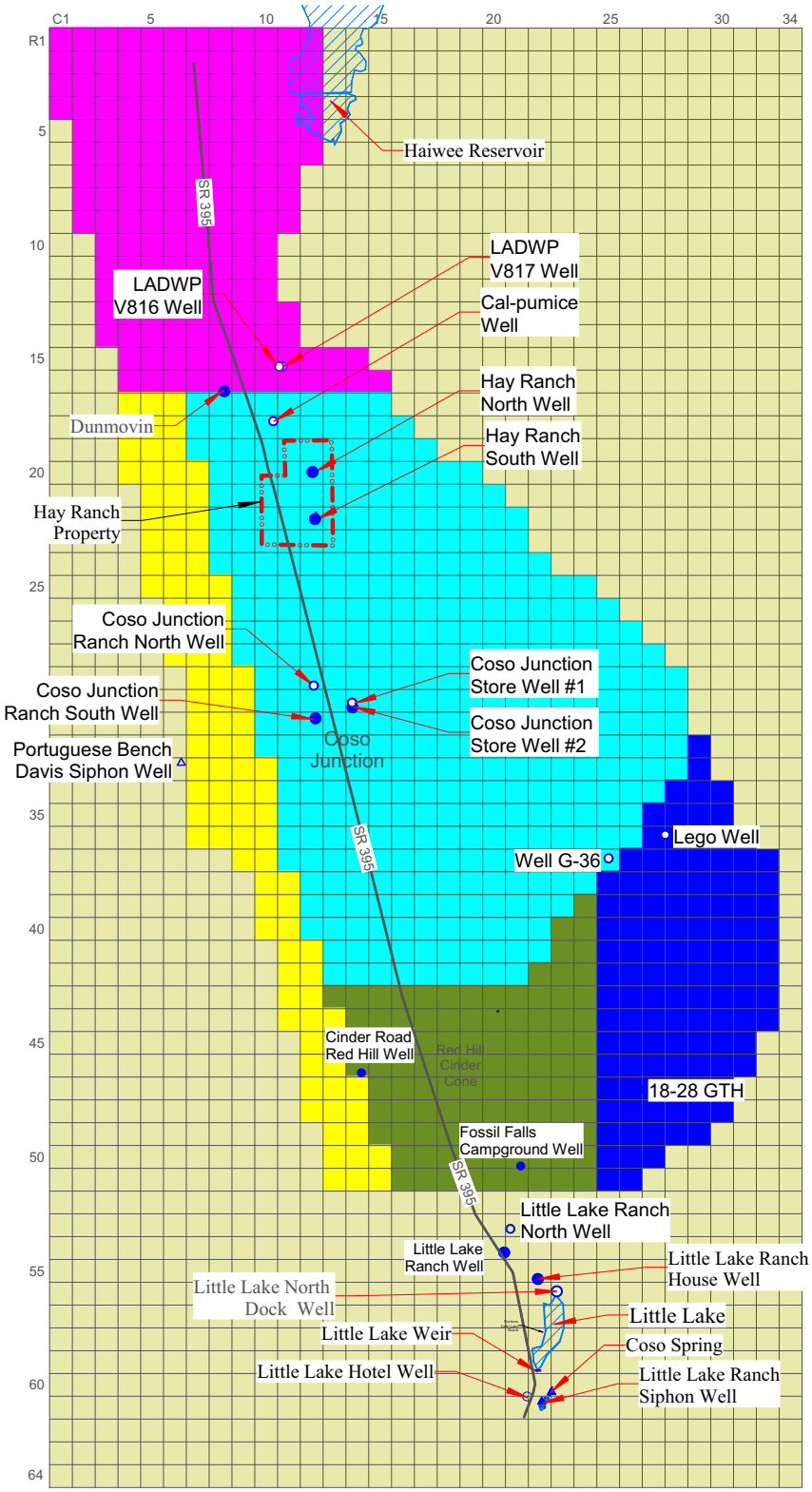
Approximate Scale in miles

0 1 2

N

Hydraulic Conductivity Distribution in Layer 2

Figure C2-9



Key

- Spring or Siphon Well
- Pumping Well
- Out-of-Use Well
- No Flow (Inactive) Cell
- Kh = 0.08 ft/day, Kz = 0.08 ft/day
- Kh = 0.03 ft/day, Kz = 0.003 ft/day
- Kh = 1.5 ft/day, Kz = 1.5 ft/day
- Kh = 2.8 ft/day, Kz = 0.28 ft/day
- Kh = 0.28 ft/day, Kz = 0.28 ft/day

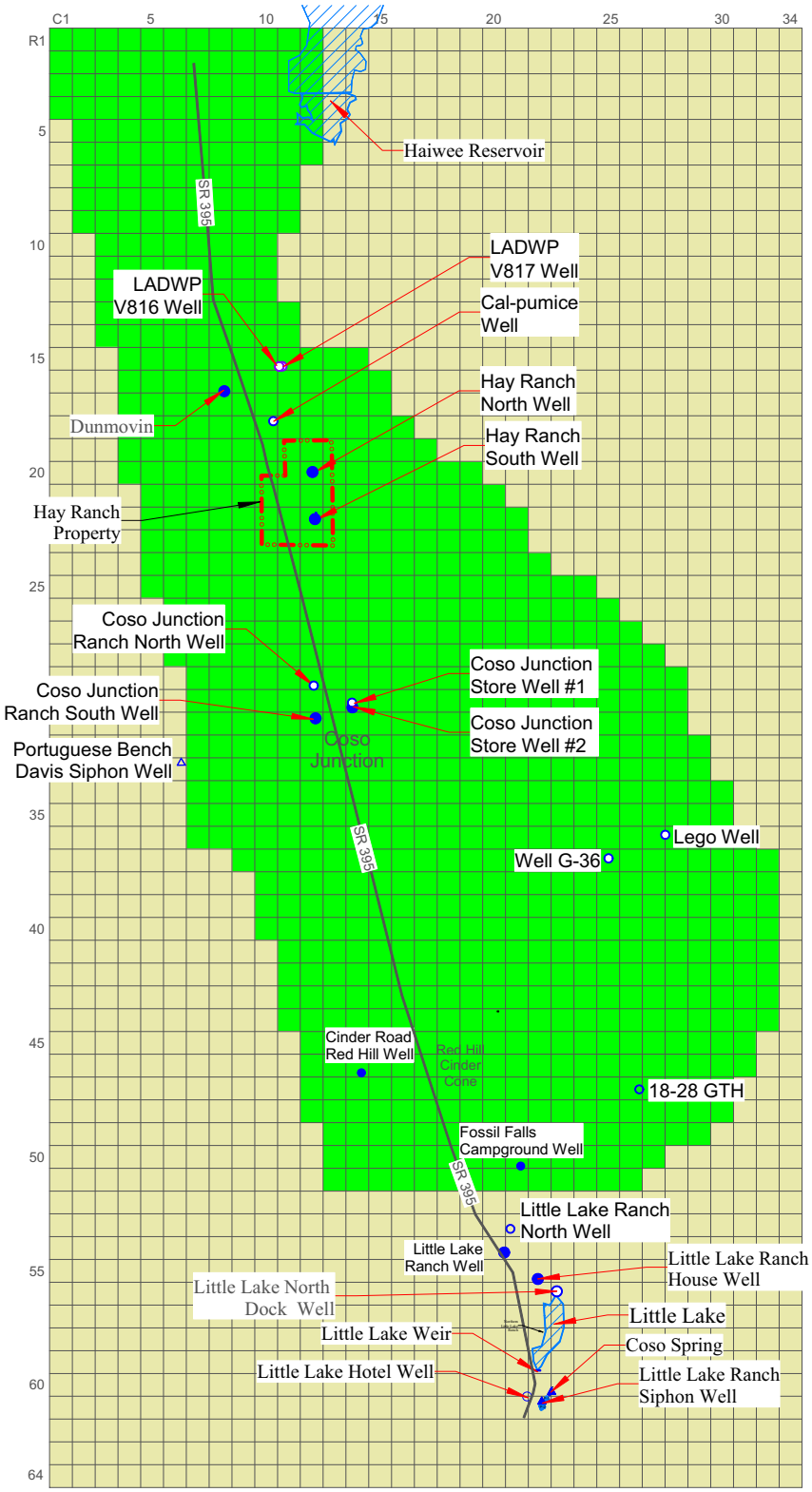
Approximate Scale in miles

0 1 2

N

Hydraulic Conductivity Distribution in Layer 3

Figure C2-10



Key

- Spring or Siphon Well
- Pumping Well
- Out-of-Use Well
- No Flow (Inactive) Cell
- Kh = 0.28 ft/day
  Kz = 0.28 ft/day

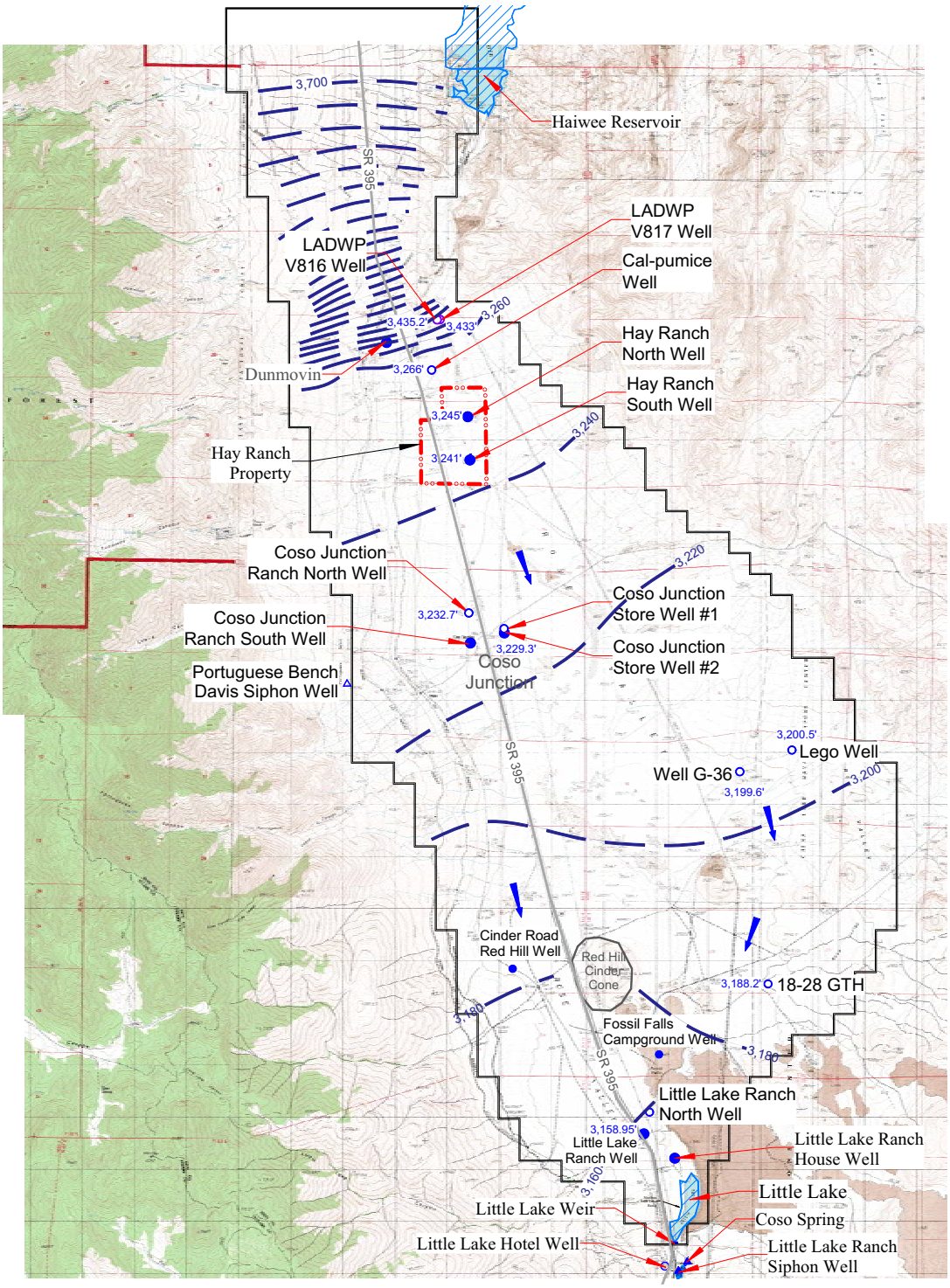
Approximate
Scale in miles

0 1 2

N

Hydraulic Conductivity Distribution in Layer 4

Figure C2-11



Key

- Spring or Siphon Well
- Pumping Well
- Out-of-Use Well
- 3,160' Predicted Groundwater Elevation Contour, ft
- 3,158.95' Groundwater Elevation Observed in November 2007
- Groundwater Flow Direction

Approximate Scale in miles

0 1 2

N

Predicted Groundwater Elevation Contours Compared to Groundwater Elevation Observed in November 2007

Figure C2-12

Figure C2-13
Comparison of Simulated versus Observed Groundwater Elevation in Recalibrated Steady-State Numerical Model

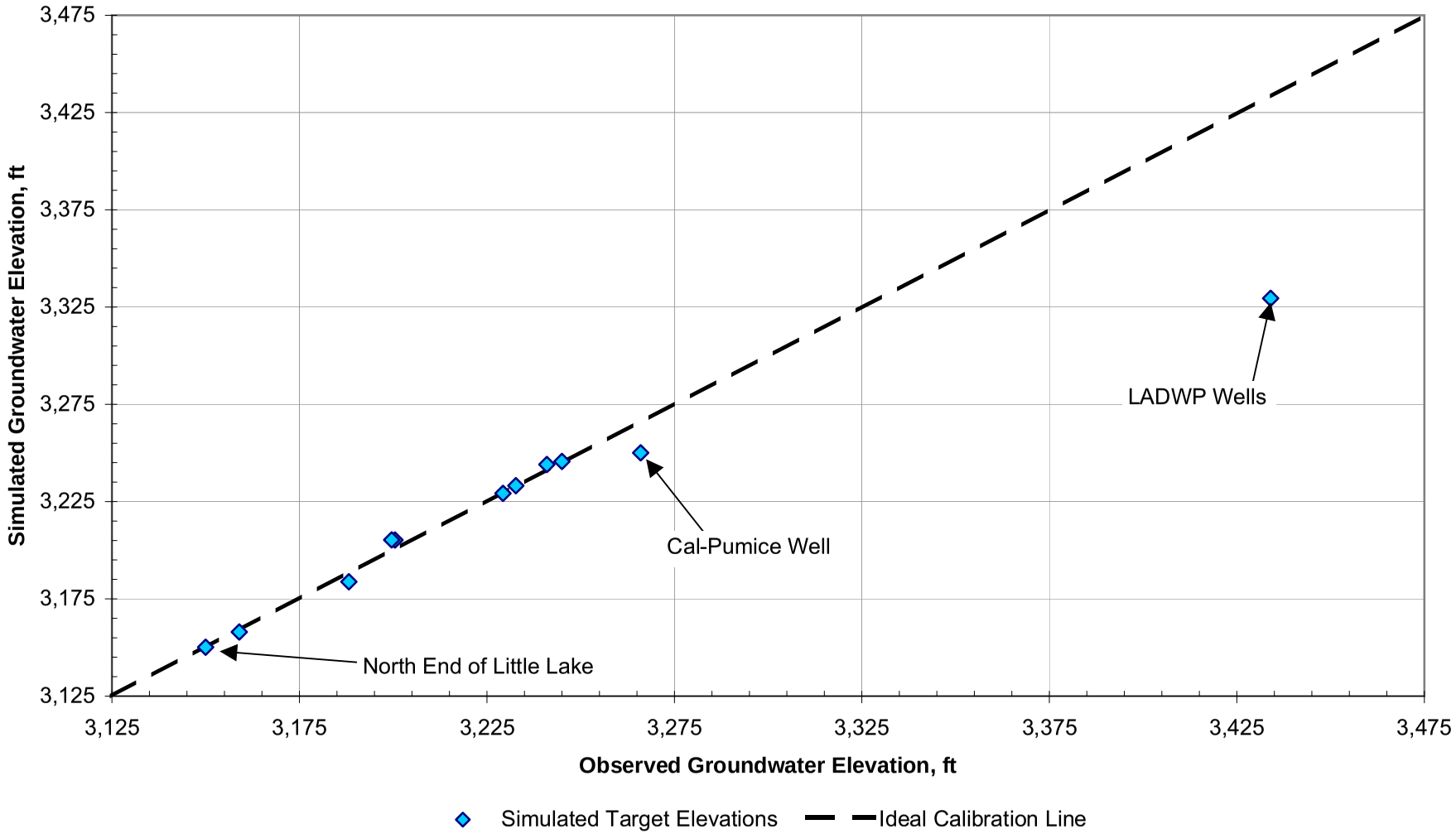
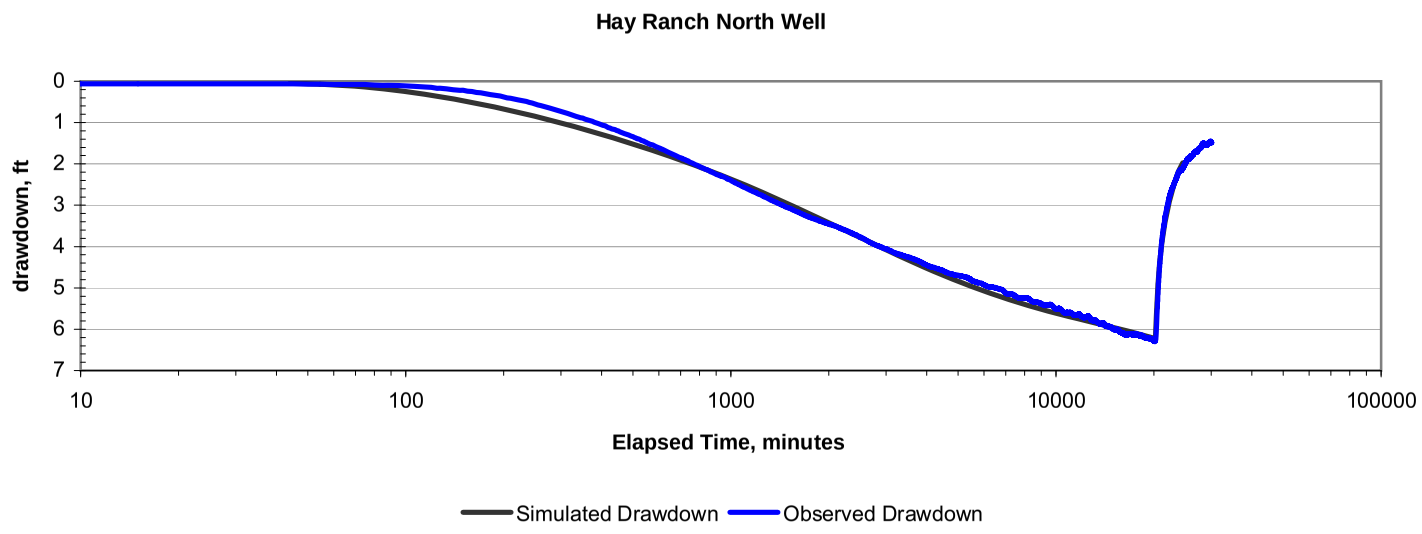
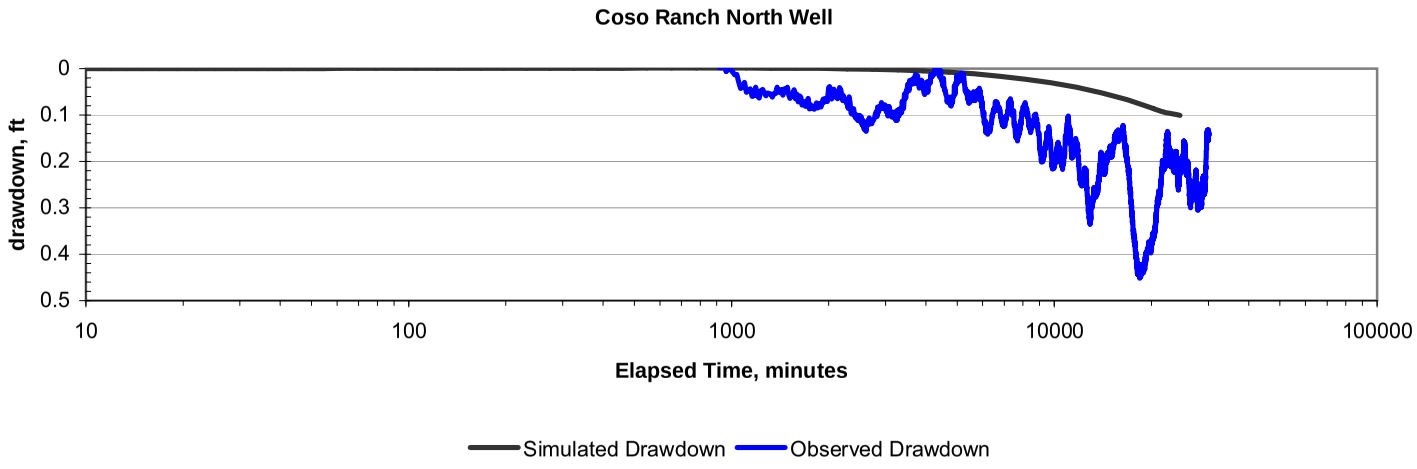
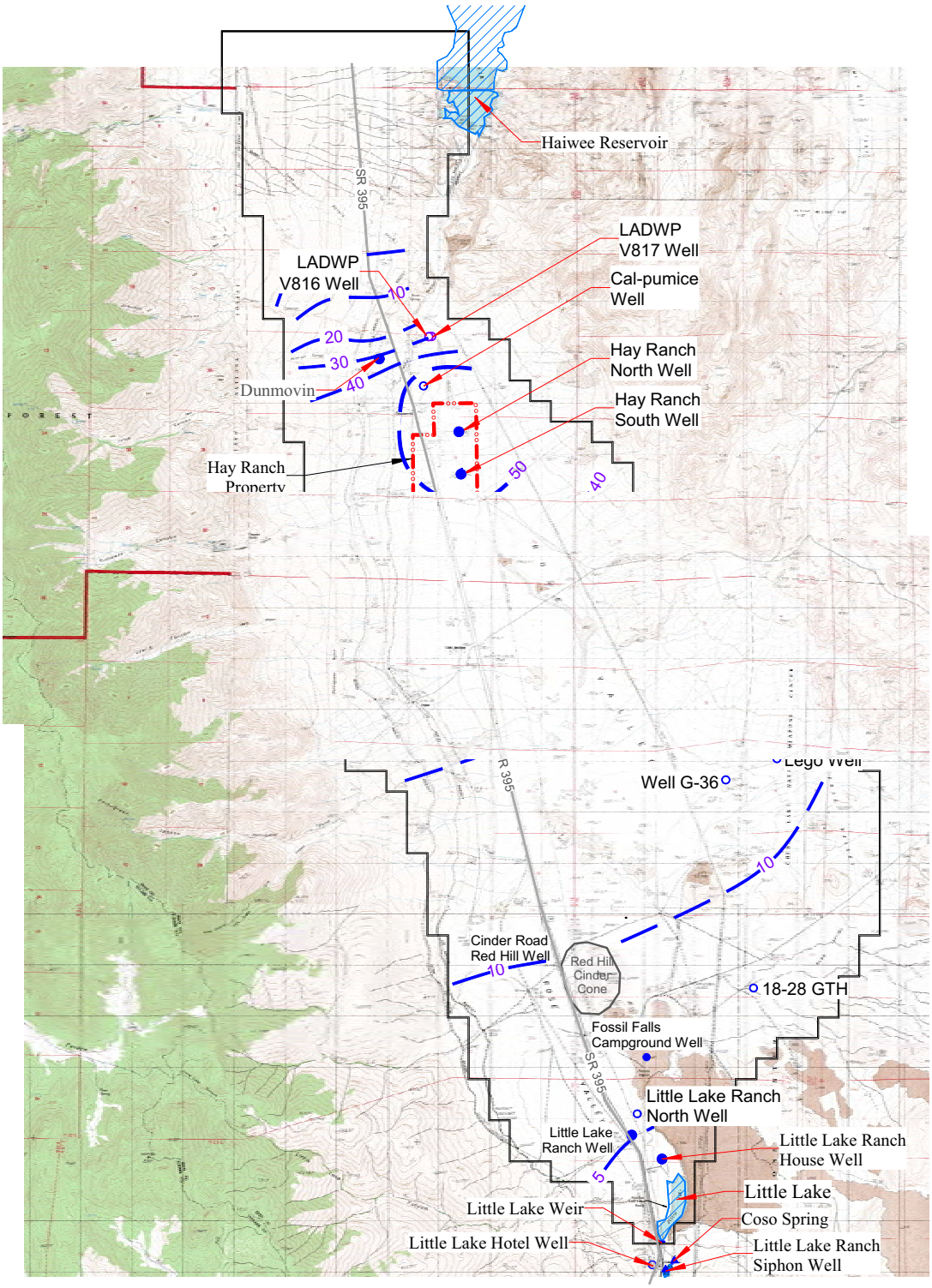


Figure C2-14
Results of Model Calibration to November/December 2007 Pumping Test







Key

- Spring or Siphon Well
- Pumping Well
- Out-of-Use Well
- Groundwater Drawdown Contour, ft
- Boundary of Numerical Model

N

Predicted Groundwater Table Drawdown after 30 Years at Full Project Development Rate of 4,839 acre-ft/yr

Figure C2-15

Table C2-1
Rose Valley EIR

November 2007 Groundwater Elevation Data
Used for Steady-State Model Calibration Targets

Well	Reference Point Elevation, ft MSL	Depth to Groundwater, ft	Groundwater Elevation, ft
LADWP V816	3,515.35	80.15	3,435.20
LADWP V817	3,511.86	78.86	3,433.00
Cal-Pumice	3,506.38	240.38	3,266.00
Hay Ranch North	3,436.78	191.78	3,245.00
Hay Ranch South	3,420.25	179.35	3,240.90
Coso Junction Store #1	3,372.10	142.80	3,229.30
Coso Ranch North	3,402.72	170.02	3,232.70
G-36	3,379.85	180.25	3,199.60
Lego	3,422.81	222.31	3,200.50
18-28 GTH	3,362.62	174.42	3,188.20
Little Lake Ranch North	3,199.15	40.20	3,158.95

Elevation survey to NGVD 1929 by triad/holme associates.

Table C2-2
Rose Valley EIR

Historic Water Level Monitoring Data

Date	Depth to Groundwater, ft	Groundwater Elevation, ft
Coso Junction Store Well #1		
December 15, 1998	139.00	3,233.10
September 27, 2002	144.75	3,227.35
November 21, 2002	144.33	3,227.77
January 13, 2003	144.25	3,227.85
March 20, 2003	144.85	3,227.25
May 6, 2003	144.51	3,227.59
October 30, 2003	144.50	3,227.60
June 30, 2004	144.22	3,227.88
September 22, 2004	144.16	3,227.94
June 10, 2005	143.52	3,228.58
July 20, 2006	143.22	3,228.88
October 13, 2006	143.00	3,229.10
April 13, 2007	142.65	3,229.45
June 22, 2007	143.34	3,228.76
August 2, 2007	142.90	3,229.20
August 29, 2007	143.25	3,228.85
November 15, 2007	142.71	3,229.39
November 19, 2007	142.80	3,229.30
November 20, 2007	143.20	3,228.90
November 22, 2007	142.85	3,229.25
November 28, 2007	143.15	3,228.95
November 29, 2007	143.09	3,229.01
December 2, 2007	143.18	3,228.92
December 3, 2007	143.32	3,228.78
December 5, 2007	143.10	3,229.00
	Top of casing elevation, ft:	3,372.10
Fossil Falls Campground Well		
October 1, 2002	141.36	--
November 21, 2002	141.42	--
March 20, 2003	141.39	--
June 10, 2005	141.13	--
July 20, 2006	141.25	--
October 13, 2006	141.20	--

Table C2-2
Rose Valley EIR

Historic Water Level Monitoring Data

Date	Depth to Groundwater, ft	Groundwater Elevation, ft
Fossil Falls (continued)		
February 19, 2007	141.25	--
June 22, 2007	141.23	--
August 2, 2007	141.25	--
	Top of casing elevation, ft:	NM
Well G-36 TGH (G-36)		
November 5, 2002	184.10	3,195.75
November 21, 2002	181.50	3,198.35
December 13, 2002	182.42	3,197.43
March 20, 2003	181.38	3,198.47
June 10, 2005	180.69	3,199.16
July 20, 2006	180.50	3,199.35
October 13, 2006	184.20	3,195.65
February 19, 2007	180.38	3,199.47
June 22, 2007	180.30	3,199.55
August 2, 2007	180.29	3,199.56
August 29, 2007	180.29	3,199.56
November 15, 2007	180.23	3,199.62
November 19, 2007	180.22	3,199.63
November 20, 2007	180.21	3,199.64
November 22, 2007	180.22	3,199.63
November 28, 2007	180.25	3,199.60
November 29, 2007	180.24	3,199.61
December 2, 2007	180.26	3,199.59
December 3, 2007	180.26	3,199.59
December 5, 2007	180.29	3,199.56
	Top of casing elevation, ft:	3,379.85

Table C2-2
Rose Valley EIR

Historic Water Level Monitoring Data

Date	Depth to Groundwater, ft	Groundwater Elevation, ft
Hay Ranch North Well		
December 15, 1998	199.00	3,237.78
September 30, 2002	193.75	3,243.03
November 21, 2002	193.85	3,242.93
January 13, 2003	193.75	3,243.03
March 20, 2003	192.26	3,244.52
December 9, 2003	193.20	3,243.58
June 30, 2004	193.00	3,243.78
September 22, 2004	192.91	3,243.87
June 10, 2005	192.32	3,244.46
July 20, 2006	192.62	3,244.16
October 13, 2006	192.29	3,244.49
February 16, 2007	192.30	3,244.48
April 13, 2007	192.15	3,244.63
June 22, 2007	191.65	3,245.13
August 2, 2007	191.60	3,245.18
November 14, 2007	191.68	3,245.10
November 15, 2007	191.65	3,245.13
November 19, 2007	191.60	3,245.18
November 20, 2007	194.30	3,242.48
November 22, 2007	196.08	3,240.70
November 28, 2007	197.61	3,239.17
November 29, 2007	197.56	3,239.22
December 2, 2007	198.07	3,238.71
December 3, 2007	198.32	3,238.46
December 5, 2007	194.14	3,242.64
December 17, 2007	192.72	3,244.06
	Top of casing elevation, ft:	3,436.78
Hay Ranch South Well		
December 15, 1998	182.00	3,238.25
September 30, 2002	181.62	3,238.63
November 21, 2002	181.46	3,238.79
January 13, 2003	181.25	3,239.00
March 20, 2003	181.10	3,239.15
May 6, 2003	180.80	3,239.45

Table C2-2
Rose Valley EIR

Historic Water Level Monitoring Data

Date	Depth to Groundwater, ft	Groundwater Elevation, ft
Hay Ranch South (continued)		
December 9, 2003	181.34	3,238.91
June 30, 2004	180.95	3,239.30
September 22, 2004	180.76	3,239.49
June 10, 2005	180.15	3,240.10
July 20, 2006	179.64	3,240.61
October 13, 2006	179.40	3,240.85
April 13, 2007	179.50	3,240.75
June 22, 2007	179.00	3,241.25
August 2, 2007	178.98	3,241.27
August 29, 2007	179.35	3,240.90
November 15, 2007	179.35	3,240.90
November 19, 2007	179.35	3,240.90
	Top of casing elevation, ft:	3,420.25
Coso Ranch North Well		
January 13, 2003	172.07	3,230.65
May 6, 2003	171.97	3,230.75
October 30, 2003	171.84	3,230.88
June 30, 2004	171.80	3,230.92
September 22, 2004	171.32	3,231.40
June 10, 2005	170.60	3,232.12
July 20, 2006	170.60	3,232.12
October 23, 2006	170.60	3,232.12
February 16, 2007	170.10	3,232.62
April 13, 2007	170.10	3,232.62
June 22, 2007	170.15	3,232.57
August 2, 2007	170.20	3,232.52
November 14, 2007	170.20	3,232.52
November 15, 2007	169.93	3,232.79
November 19, 2007	170.02	3,232.70
November 20, 2007	170.10	3,232.62
November 22, 2007	170.07	3,232.65
November 28, 2007	170.44	3,232.28

Table C2-2
Rose Valley EIR

Historic Water Level Monitoring Data

Date	Depth to Groundwater, ft	Groundwater Elevation, ft
Coso Ranch North (continued)		
November 29, 2007	170.22	3,232.50
December 2, 2007	170.50	3,232.22
December 3, 2007	170.56	3,232.16
December 5, 2007	170.25	3,232.47
	Top of casing elevation, ft:	3,402.72
LADWP Well V817 (LADWP #1)		
June 30, 2004	72.90	3,438.96
September 22, 2004	77.63	3,434.23
June 10, 2005	79.70	3,432.16
July 20, 2006	77.70	3,434.16
October 13, 2006	78.09	3,433.77
February 16, 2007	76.70	3,435.16
April 13, 2007	76.45	3,435.41
June 22, 2007	77.15	3,434.71
August 2, 2007	76.63	3,435.23
August 29, 2007	77.15	3,434.71
November 15, 2007	78.70	3,433.16
November 19, 2007	78.81	3,433.05
November 20, 2007	78.82	3,433.04
November 22, 2007	78.88	3,432.98
November 28, 2007	79.07	3,432.79
November 29, 2007	79.00	3,432.86
December 2, 2007	79.17	3,432.69
December 3, 2007	79.17	3,432.69
December 5, 2007	79.06	3,432.80
	Top of casing elevation, ft:	3,511.86

Table C2-2
Rose Valley EIR

Historic Water Level Monitoring Data

Date	Depth to Groundwater, ft	Groundwater Elevation, ft
LADWP Well V816 (LADWP #2)		
May 6, 2003	77.08	3,438.27
October 30, 2003	79.14	3,436.21
June 10, 2005	80.80	3,434.55
July 20, 2006	78.85	3,436.50
October 13, 2006	77.01	3,438.34
February 19, 2007	75.42	3,439.93
April 13, 2007	75.35	3,440.00
June 22, 2007	76.00	3,439.35
August 2, 2007	77.82	3,437.53
August 29, 2007	78.30	3,437.05
November 14, 2007	80.20	3,435.15
November 15, 2007	80.20	3,435.15
November 19, 2007	80.14	3,435.21
November 20, 2007	80.16	3,435.19
November 22, 2007	80.18	3,435.17
November 28, 2007	80.34	3,435.01
November 29, 2007	80.31	3,435.04
December 2, 2007	80.46	3,434.89
December 3, 2007	80.43	3,434.92
December 5, 2007	80.39	3,434.96
	Top of casing elevation, ft:	3,515.35
Lego Well		
February 11, 2003	223.40	3,199.41
February 18, 2003	223.60	3,199.21
June 10, 2005	222.82	3,199.99
July 20, 2006	222.82	3,199.99
October 13, 2006	227.10	3,195.71
February 16, 2007	222.70	3,200.11
June 22, 2007	222.50	3,200.31
August 2, 2007	222.50	3,200.31
November 15, 2007	222.34	3,200.47
November 19, 2007	222.32	3,200.49
November 20, 2007	222.42	3,200.39
November 22, 2007	222.41	3,200.40

Table C2-2
Rose Valley EIR

Historic Water Level Monitoring Data

Date	Depth to Groundwater, ft	Groundwater Elevation, ft
Lego (continued)		
November 28, 2007	222.58	3,200.23
November 29, 2007	222.37	3,200.44
December 2, 2007	222.69	3,200.12
December 3, 2007	222.63	3,200.18
December 5, 2007	222.41	3,200.40
	Top of casing elevation, ft:	3,422.81
Cal-Pumice (Pumice Mine) Well		
December 15, 1998	242.00	3,264.38
June 30, 2004	241.52	3,264.86
September 22, 2004	241.24	3,265.14
June 10, 2005	240.91	3,265.47
July 20, 2006	240.74	3,265.64
October 23, 2006	240.73	3,265.65
February 16, 2007	241.70	3,264.68
April 13, 2007	240.60	3,265.78
June 22, 2007	240.00	3,266.38
August 2, 2007	239.98	3,266.40
August 29, 2007	240.00	3,266.38
November 14, 2007	240.31	3,266.07
November 15, 2007	240.30	3,266.08
November 19, 2007	240.42	3,265.96
November 20, 2007	240.40	3,265.98
November 22, 2007	240.50	3,265.88
November 28, 2007	240.83	3,265.55
November 29, 2007	240.52	3,265.86
December 2, 2007	241.14	3,265.24
December 3, 2007	241.05	3,265.33
December 5, 2007	240.38	3,266.00
	Top of casing elevation, ft:	3,506.38

NM - Not surveyed, elevation cannot be calculated.
Elevation survey to NGVD 1929 by triad/holme associates.

Table C2-3
Rose Valley EIR

Summary of Bauer (2002) Stream and Spring Flow Measurements

Location	Date Measured	Instantaneous Flow Rate, acre-ft/yr
Coso Spring	10/28/1996	1,311
South Culvert(1)	10/28/1996	318
Coso Spring	2/2/1997	1,382
Little Lake Weir	2/2/1997	1,299
North Culvert(2)	2/2/1997	3,924
South Culvert	2/2/1997	515
Coso Spring	5/14/1997	1,451
Little Lake Weir	5/14/1997	312
North Culvert	5/14/1997	2,043
South Culvert	5/14/1997	583
Little Lake Weir	6/2/1997	166
North Culvert	6/2/1997	2,646
South Culvert	6/2/1997	676
Coso Spring	7/11/1997	1,976
Little Lake Weir	7/11/1997	0
North Culvert	7/11/1997	885
South Culvert	7/11/1997	428
Coso Spring	10/1/1997	1,949
Little Lake Weir	10/1/1997	217
North Culvert	10/1/1997	2,384
South Culvert	10/1/1997	627
Coso Spring	2/7/1998	1,222
Little Lake Weir	2/7/1998	1,746
North Culvert	2/7/1998	5,357
South Culvert	2/7/1998	1,866
Coso Spring	3/25/1998	874
Little Lake Weir	3/25/1998	887
North Culvert	3/25/1998	3,439
South Culvert	3/25/1998	917

Notes:

(1) Most southerly surface water flow measurement point on the property.

(2) Flow rate in ditch discharging from lower Little Lake pond (P-2); contains combined flow from Little Lake Weir, Coso Spring, and siphon well.

Appendix C3 - Hydrogeochemical Data

Geochemical Database for Rose Valley Hydrological Sysyem Based on Guler, 2002 with Additional Data

SITE NAME	LATITUDE	LONGITUDE	DATE	TEMP	ALK	HARDNESS	COND	pH	Ca	Mg	Na	K	Cl	SO4	HCO3	SiO2	Cl/B	B	Br	Deuterium ‰	Oxygen-18 ‰	TDS	TDS(sum)	BALANCE	DATA SOURCE
WILD ROSE RANCH SPRING	360245	1175833	790400	5.00	232.79	209.94	-9999	7.70	66.00	11.00	24.00	4.00	9.0	37.0	284.0	30.0	45.0	0.20		-102.0	-13.9	465	465	-3.16	10
TUNAWEE CANYON SPRING, SIERRA NEVADA	360349	1180000	970521	16.60	312.00	266.46	620	8.13	77.11	18.00	26.99	4.50	8.6	35.9	343.0	26.2	107.5	0.08	0.050			230	540	3.92	5
SOUTH KENNEDY MEADOWS (GOVERNMENT SPRING)	355818	1180529	960824	22.60	242.00	214.74	525	7.80	57.70	17.20	18.30	3.71	8.8	49.7	256.0	28.9	175.8	0.05	0.040	-105.0	-13.7	331	440	-2.87	25
SOUTH FORK KERN RIVER "1"	361000	1180620	960331	7.78	59.40	37.15	138	8.47	10.70	2.54	11.10	1.78	7.9	3.0	54.2	20.3	98.4	0.08	0.007	-108.0	-14.7	84	112	3.90	5
SACATAR CANYON SPRING	355842	1180259	960824	22.00	285.00	180.19	501	7.90	48.80	14.20	21.80	3.91	12.3	29.8	252.0	25.9	246.0	0.05	0.040	-110.0	-14.4	293	409	-4.77	25
S. NEV. FAULT	355730	1175610	950517	16.20	167.21	272.44	-9999	7.40	80.00	17.70	58.00	7.10	45.4	161.0	204.0	23.0		0.05	0.240	-101.0	-12.5	505	596	0.37	5
ROUND MEADOW	355806	1182110	960727	14.70	12.00	16.30	56	6.90	5.13	0.85	2.50	0.22	0.2	0.4	22.9	16.6	4.4	0.05	0.040	-95.0	-12.7	46	49	5.44	25
ROCK HOUSE SPRING	355310	1181211	960825	25.30	162.00	56.83	330	7.80	20.80	1.20	50.10	0.76	2.6	8.1	186.0	53.7	52.0	0.05	0.040	-102.0	-13.7	240	323	-1.37	25
RED HILL WELL, ROSE VALLEY	355903	1175630	980515	19.00	204.00	177.65	570	7.53	46.33	15.08	44.04	6.51	25.3	8.2	346.0	0.0	361.4	0.07	0.510			492	492	-0.13	5
Fossil Falls																				-103.0	-13.7				GeoTrans 2004
PROTUGESE BENCH SPRING, ROSE VALLEY	360244	1175826	970602	20.00	190.00	196.50	450	7.73	61.49	10.47	17.81	3.37	5.1	26.9	248.8	25.0	96.2	0.05	0.030			399	399	-0.09	5
Portugese Bench-new			71213										5.8				52.7	0.11		-100.1	-13.9	280			Coso 07
PHIL HENNIS RANCH WELL	360500	1175704	790400	22.5	250.00	292.50	-9999	7.20	76.00	25.00	109.00	10.20	65.0	140.0	305.0	42.0	68.4	0.95		-112.0	-14.5	774	773	5.23	10
LADPW																				-111.8	-14.5				GeoTrans, 04
Rose Valley Rnch	360458	115703	790400					8.13	111.00	28	114.00	11.00	75.0	200.0	256.0	30.0	75.0	1.00		-109.0	-13.8	827	826		10
Rose Valley Rnch	360458	115703	790400					7.93	110.00	28	120.00	11.00	70.0	190.0	261.0	33.0	70.0	1.00		-111.0	-13.9	825	824		10
Rose Valley Rnch	360458	115703	790400					7.8	109.00	28	118.00	10.00	72.0	200.0	248.0	31.0	90.0	0.80		-109.0	-14.2	817	817		10
Hay Ranch North			2002						96.30	36.00	133.00	9.38	79.0	329.0	250.0					-107.8	-14.4	945	933		GeoTrans, 04
Hay Ranch South			2002						113.00	37.70	111.00	11.80	75.7	251.0	320.0							844	920		GeoTrans, 04
Hay Ranch South-new			71213										73.0				56.2	1.30		-107.5	-14.3	820			Coso 07
LEGO									91.10	64.40	685.00	20.10	898.0	94.9	346.0	28.8	707.1	1.27		-103.8	-10.3	2540	2230		
18-29GTH					1183.00			8.42	34.20	47.19	614.40	43.36	514.2	61.7	1183.0	108.0	13.4	38.25	4.880			2045	2098	2.44	Navy, 2007
MOSQUITO MEADOW	355624	1182043	960728	18.9	18.00	18.33	64	7.10	5.02	1.41	3.80	1.23	0.6	1.3	27.6	21.6	11.0	0.05	0.040	-105.0	-13.6	53	63	6.06	25
LL-W4 LITTLE LAKE	355615	1175355	951017	21.4	392.62	410.93	1580	8.17	75.80	53.90	223.00	26.10	188.0	106.0	479.0	53.3	32.9	5.71	0.550	-104.0	-13.6	978	1211	9.42	5
LL-W4 LITTLE LAKE	355615	1175355	950506	19.6	639.00	429.18	-9999	7.20	78.00	57.00	256.00	22.00	108.0	182.0	780.0	66.0	20.8	5.20	0.420	-106.0	-12.5	1150	1554	1.56	5
LL-W3 LITTLE LAKE	355728	1175400	951017	25.9	510.66	395.17	1260	7.57	93.40	39.40	151.00	17.80	48.4	69.8	623.0	52.4	21.1	2.29	0.310	-98.0	-12.4	901	1097	6.67	5
LL-W3 LITTLE LAKE	355728	1175400	950506	24.3	631.00	400.76	-9999	7.00	93.00	41.00	167.00	14.60	79.0	49.7	770.0	64.0	37.6	2.10	0.160	-107.0	-14.1	890	1280	-0.83	5
LL-W3 LITTLE LAKE	355728	1175400	940915	24.1	660.00	420.00	1400	7.30	98.00	42.00	160.00	11.00	52.0	81.0	810.0	75.0	28.9	1.80		-107.0	-13.9	920	1331	-2.89	5
LL-W2 LITTLE LAKE	355730	1175405	951017	22.3	300.82	295.80	1300	8.04	66.60	31.50	166.00	23.40	158.0	96.3	367.0	46.1	39.1	4.04	0.500	-104.0	-14.2	837	959	4.69	5
LL-W2 LITTLE LAKE	355730	1175405	950506	18.6	418.00	350.86	-9999	7.70	73.00	41.00	228.00	22.00	127.0	211.0	510.0	61.0	25.9	4.90	0.520	-108.0	-13.4	1120	1278	3.34	5
LL-W2 LITTLE LAKE	355730	1175405	940915	21.4	370.00	300.00	1300	8.10	65.00	33.00	160.00	20.00	160.0	100.0	450.0	69.0	55.2	2.90		-103.0	-13.3	830	1060	-2.22	5
LL-W1 LITTLE LAKE	355726	1175349	950504	23.9	1430.00	820.35	1570	7.30	182.00	89.00	434.00	29.00	108.0	192.0	1750.0	76.0	9.8	11.00	0.410			2010	2871	0.37	5
LL-W1 LITTLE LAKE	355726	1175349	940915	23.1	1700.00	970.00	3300	6.90	220.00	100.00	460.00	34.00	220.0	120.0	2100.0	110.0	20.0	11.00				2300	3375	-3.89	5
LL-SPG-2 LITTLE LAKE	355655	1175404	951017	20.2	346.72	296.75	983	7.12	68.30	30.70	116.00	12.80	69.0	82.3	423.0	35.9	33.5	2.06	0.370	-101.0	-12.4	621	840	3.04	5
LL-S2 LITTLE LAKE	355610	1175402	951007	17.1	450.82	365.16	1730	8.15	46.90	60.30	256.00	27.40	194.0	106.0	550.0	50.8	30.1	6.45	0.570	-103.0	-13.4	1070	1298	6.74	5
LL-S2 LITTLE LAKE	355610	1175402	950506	15.6	655.00	430.41	-9999	8.20	62.00	67.00	285.00	24.00	133.0	193.0	740.0	59.0	22.9	5.80	0.490	-109.0	-10.5	1220	1569	4.04	5
LL-S1 LITTLE LAKE	355508	1175400	951007	18.7	444.26	343.65	1700	8.26	39.10	59.80	271.00	28.60	204.0	114.0	542.0	18.4	32.0	6.37	0.520	-94.0	-11.1	1113	1283	6.46	5
LL-S1 LITTLE LAKE	355508	1175400	950506	15.2	614.00	365.54	-9999	8.70	36.00	67.00	297.00	25.00	201.0	140.0	601.0	51.0	34.1	5.90	0.510	-94.0	-9.9	1190	1424	6.08	5
LL-P1 LITTLE LAKE Pond	355615	1175355	951017	21.4	513.11	408.48	1720	7.85	79.60	51.00	230.00	24.90	182.0	105.0	626.0	44.8	32.6	5.58	0.480	-92.0	-11.3	1120	1349	3.30	5
LL-P1 LITTLE LAKE	355615	1175355	950506	19.5	633.00	434.17	-9999	7.40	80.00	57.00	250.00	22.00	110.0	183.0	772.0	67.0	21.2	5.20	0.400	-107.0	-12.7	1160	1546	1.31	5
LL-L2 LITTLE LAKE Lake	355630	1175350	951007	17.6	122.95	70.63	2260	10.18	5.71	13.70	432.00	34.40	269.0	352.0	150.0	5.6	35.8	7.52	0.850	-33.0	0.2	1440	1270	9.47	5
LL-L2 LITTLE LAKE	355630	1175350	950520	21.4	565.00	337.21	-9999	9.20	13.10	74.00	317.00	30.00	178.0	220.0	689.0	22.0	33.8	5.27	0.490	-65.0	-5.3	1200	1548	0.80	5
LL-L1 LITTLE LAKE	355706	1175340	960413	15.0	646.77	366.10	1980	8.85	26.00	73.20	331.00	28.80	189.0	219.0	633.0	38.7	47.8	3.95	0.548	-58.0	-5.0	1220	1543	4.99	5
LL-L1 LITTLE LAKE	355706	1175340	951007	19.9	184.43	134.45	2090	9.71	8.53	27.50	385.00	33.00	247.0	295.0	225.0	12.8	35.3	6.99	0.790	-45.0	-2.2	1360	1241	9.22	5
LL-L1 LITTLE LAKE	355706	1175340	950520	23.6	567.00	347.69	-9999	9.00	17.30	74.00	308.00	29.00	176.0	216.0	692.0	25.0	33.8	5.20	0.480	-66.0	-5.6	1200	1543	0.53	5
LL-L1 LITTLE LAKE	355706	1175340	940901	22.3	530.00	84.00	3100	11.00	7.00	16.00	590.00	57.00	370.0	480.0	480.0	4.0	52.9	7.00		-23.0	-4.3	1900	2011	0.57	5
LL STREAM, S. CULVERT, ROSE VALLEY	355530	1175500	970514	22.2	916.00	342.84	2030	8.82	39.60	59.30	263.70	21.30	205.2	141.1	623.2	46.8	35.1	5.85	0.430			1010	1406	-0.24	5
LL S. DOCK, LITTLE LAKE	355644	1175400	980517	18.0	218.00	233.35	1470	9.98	6.29	52.89	277.42	21.73	205.7	13.1	1108.9	0.0		0.46	1.090			750	1686	3.81	5
LL RANCH HOUSE WELL, ROSE VALLEY	355729	1175417	970602	21.1	312.00	280.95	1330	7.58	63.14	29.99	147.80	16.96	151.9	96.8	377.6	54.5	41.6	3.66	0.330	-105.0		660	942	-0.27	5
LL N. DOCK, LITTLE LAKE	355716	1175400	980207	8.0	396.00	300.08	1800	8.35	30.99	54.13	290.55	25.31	233.2	19.7	1388.2	0.0	55.8	4.18	1.050			900	2046	6.34	5
LL FAULT SPRING, ROSE VALLEY	355546	1175450	970214	20.4	143.00	263.14	1110	7.90	73.80	19.20	159.30	6.60	38.2	382.9	194.9	26.4	100.5	0.38	0.140			550	902	-0.08	5
LL EFF. STRM (6838), LITTLE LAKE	355630	1175400	940901	19.4	500.00	390.00	1900	8.40	49.00	64.00	260.00	19.00	230.0	150.0	600.0	72.0	50.0	4.60		-96.0	-10.8	1200	1449	-0.11	5
LL CANYON SPRING, SIERRA NEVADA	355704	1175610	970531	25.5	251.00	305.42	810	7.99	88.12	20.79	48.64	5.57	31.7	81.7	343.3	27.5	194.5	0.16	0.120			400	648	-0.07	5
LL CANYON 2	355645	1175620	950506	17.5	294.00	295.13	-9999	8.30	82.00	22.00	56.00	6.90	30.6	83.0	359.0	28.0	161.1	0.19	0.130	-101.0	-13.0	520	668	-0.58	5
LL CANYON 1	355700	1175610	950328	-9999.0	246.00	251.61	-9999	8.80	70.00	18.70	46.00	6.50	25.3	79.0	291.0	26.0	148.8	0.17	0.080	-95.0	-12.0	435	563	-0.32	5
LITTLE LAKE SPRING	355527	1175436	940227	17.1	431.15	327.70	1169	7.58	71.80	36.10	128.00	13.00	80.5	90.1	526.0	57.1				-103.0	-13.5	683	1003	-1.25	9
Northern LL Ranch Well									90.58	33.64	15.97	0.43	46.5	71.9	315.0	55.0	24.0	1.94					631		
Little Lake N-new			71213										74.0				43.5	1.70		-101.6	-13.8	650			Coso 07
Little Lake E Spring-new			71213										180.0				32.1	5.60		-100.5	-13.3	1110			Coso 07
Little Lake Spring, upper			86																	-97.0	-12.4				Bowman, UURI
Little Lake surface, lower			86																	-95.0	-11.1				Bowman, UURI
Little Lake surface, middle			86																	-94.0	-10.8				Bowman, UURI
COSO SPRING, LL RANCH, ROSE VALLEY	355615	1175250	970514	21.1	953.00	411.11	1250	7.31	82.70	49.76	213.30	17.90	180.6	106.1	653.2	60.8	34.9	5.18	0.380			931	1370	-0.25	5
B01, LITTLE LAKE	355637	1175417	930311	17.0	615.00	414.00	1900	8.30	59.00	65.00	282.00	26.00	193.0	163.0	750.0	29.0	35.1	5.50		-90.0	-10.1	1240	1573	0.10	12
LIEN WELL, SAGEFLAT RD.	361038	1175855	980502	17.0	280.00	315.56	870	7.72	92.25	20.75	62.41	3.55	134.6	11.6	317.0	2.0	1121.7	0.12	0.370			430	644	-0.67	5
KENNEDY MEADOWS, D5	360422	1180344	930413	8.0	42.00	28.00	102	6.98	8.00	2.00	12.00	2.00	9.0	4.0	51.0	22.0	11.3	0.80		-107.0	-14.3	110	111	-1.59	12
JORDAN HOT SPRING	361339	1181808	770000	43.0	1213.11	430.83	-9999	6.15	110.00	38.00	970.00	92.00	880.0	250.0	1480.0	190.0	40.0	22.00	1.600	-100.0	-12.4	3080	4032	-1.04	1
HAIWEE SPRING, COSO RANGE	360702	1174520	930506	12.0	221.00	234.00	645	7.60	64.00	18.00	47.00	6.00	40.0	63.0	269.0	41.0	26.7	1.50		-100.0	-13.7	550	550	0.09	12
HAIWEE SPRING, COSO RANGE	360702	1174520	790400	17.0	140.16	135.83	-9999	7.20	33.00	13.00	31.00	4.40	15.0	47.0	171.0	51.0	75.0	0.20		-96.0	-13.5	366	366	-0.56	10
HAIWEE SPRING, COSO RANGE	360702	1174520	740000	20.0	140.16	157.72	-9999	7.84	36.00	16.50	28.50	5.90	18.0	66.0	171.0	52.6	60.0	0.30		-98.0	-13.2	395	395	-1.66	10
HAIWEE RIDGE SPRING	360811	1175620	980517	18.0	142.00	87.15	400	8.08	25.43	5.76	44.57	5.83	19.1	40.9	253.8	0.6	45.5	0.42	0.050			396	396	-2.63	5
HAIWEE RESERVOIR, SOUTH DAM, ROSE VALLEY	360827	1175700	970531	8.0	39.00	70.79	300	8.20	20.90	4.53	35.30	3.90	17.3	34.6	111.2	15.8	32.0	0.54	0.030			244	244	-0.30	5
HAIWEE RESERVOIR, ROSE VALLEY	361106	1175745	790400	14.0	124.59	68.86	-9999	7.60	21.00	4.00	35.00	3.60	17.0	17.0	152.0	26.0	37.8	0.45	0.030	-117.0	-14.3	276	276	-5.71	10
HAIWEE PUMP STATION STREAM, ROSE VALLEY	360612	1175715	970531	16.0	37.00	93.41	380	8.20	27.64	5.94	45.97	5.73	17.5	34.1	169.6	40.6	33.7	0.52	0.040			348	348	-0.20	5
HAIWEE CREEK	360815	1180148	980517	7.0	233.00	193.57	560	8.45	52.99	14.91	37.81	5.08	31.6	35.7	368.8	8.3	395.0	0.08	0.210			555	555	4.14	5
Haiwee Cyn	360818	1180173	790400					7.90	62.00	18.00	39.00	6.00	28.0	32.0	327.0	62.0	46.7	0.60		-109.0	-14.7	575	575		10
GRUMPY BEAR WELL IWV1	355920	1180556	860916	12.0	290.00	312.00	830	7.49	82.00	26.00	52.00	6.00	19.0	99.0	290.0	21.5	380.0	0.05				436	596	7.88	29

Geochemical Database for Rose Valley Hydrological Sysyem Based on Guler, 2002 with Additional Data

SITE NAME	LATITUDE	LONGITUDE	DATE	TEMP	ALK	HARDNESS	COND	pH	Ca	Mg	Na	K	Cl	SO4	HCO3	SiO2	Cl/B	B	Br	Deuterium ‰	Oxygen-18 ‰	TDS	TDS(sum)	BALANCE	DATA SOURCE
GRUMPY BEAR WELL IWV1	355920	1180556	790400	5.0	272.13	312.46	-9999	-9999.00	84.00	25.00	55.00	5.50	21.0	90.0	332.0	24.0	140.0	0.15		-106.0	-13.5	637	637	5.00	10
FIVE MILE CANYON SIDE STREAM	355304	1175658	960504	17.6	265.20	285.36	740	8.10	67.20	28.60	50.80	8.38	26.8	91.1	322.0	33.7	141.1	0.19	0.087	-99.0	-12.5	482	629	0.94	5
EDGAR'S SPRING	355540	1180032	960824	21.0	389.00	284.06	703	7.67	80.70	20.10	32.00	3.73	25.5	37.4	373.0	31.3	212.5	0.12	0.040	-109.0	-14.1	417	604	-3.11	25
DUNMOVIN WELL, ROSE VALLEY	360527	1175700	970531	30.0	229.00	307.21	1280	8.00	78.96	26.78	150.70	6.40	52.0	330.0	276.2	29.6	29.8	1.75	0.140			952	952	-0.14	5
DEWS WELL, LAKEVIEW DR.	360916	1175810	980516	17.0	144.00	227.80	610	7.42	59.70	19.16	31.64	2.90	77.3	11.5	290.0	4.3	286.3	0.27	0.200			497	497	-2.06	5
DEAD END SPRING, COSO RANGE	360739	1174137	790400	12.0	215.57	213.18	-9999	6.95	64.00	13.00	35.00	1.70	23.0	30.0	263.0	34.0	115.0	0.20		-96.0	-12.9	464	464	2.01	10
COSO JUNC. WEST WELL, ROSE VALLEY	360252	1175715	970521	22.2	179.00	208.40	680	7.71	60.98	13.67	52.46	5.33	40.5	71.9	233.8	24.7	663.9	0.06	0.170			503	503	-0.06	5
COSO JUNC. STORE WELL, ROSE VALLEY	360235	1175638	970521	24.4	303.00	363.88	970	7.39	89.60	34.10	54.50	9.10	45.6	119.2	369.5	61.7	138.2	0.33	0.190			784	784	-0.13	5
JUNC. US395 WELL	360237	1175646	740000	23.0	245.90	252.58	-9999	7.53	60.00	25.00	40.00	3.00	26.0	68.0	300.0	41.3	130.0	0.20		-102.0	-13.6	564	564	-1.53	10
Junction Store	F-04																			-100.5	-13.9				GeoTrans, 2004
Coso Junction #1-new	7-Dec												33.0				100.00	0.33		-101.5	-13.8	510			Coso, 2007
COLES SPRING, COSO RANGE	360900	1174008	790400	13.0	147.54	307.86	-9999	7.18	97.00	16.00	44.00	2.40	30.0	140.0	180.0	42.0	150.00	0.20		-98.0	-12.8	860	552	9.41	10
CHINA GARDEN SPRINGS, COSO RANGE	361203	1173623	790400	14.5	126.23	237.87	-9999	-9999.00	64.00	19.00	54.00	8.10	55.0	130.0	154.0	38.0	137.50	0.40		-92.0	-13.1	523	523	3.53	10
CHIMNEY PEAK SPRING	355301	1180328	790400	9.0	223.77	228.15	-9999	6.90	70.00	13.00	18.00	3.60	18.0	36.0	273.0	29.0	120.00	0.15		-102.0	-13.6	461	461	-2.71	10
BIG PINE SPRING	355650	1180451	790400	7.0	177.05	173.26	-9999	7.00	48.00	13.00	23.00	3.50	12.0	32.0	216.0	22.0	100.00	0.12		-104.0	-13.8	370	370	-0.04	10
ARTESIAN WELL, ROSE VALLEY	355603	1175417	970521	22.2	545.00	395.42	1830	6.77	77.50	49.10	217.30	18.60	181.3	104.6	647.0	59.1	35.55	5.10	0.350			922	1360	-0.25	5
21S/32E-31Q01 KENNEDY MEADOWS	360000	1180500	950402	-9999.0	52.05	40.04	-9999	8.00	11.10	3.00	16.70	4.00	13.1	3.7	63.5	8.9	21.13	0.62	0.025	-112.0	-14.7	110	125	4.30	5
21S/32E-31Q01 KENNEDY MEADOWS	360000	1180500	940601	-9999.0	147.54	124.36	-9999	8.00	35.00	9.00	41.00	5.00	40.0	16.0	180.0	15.0	28.57	1.40		-101.0	-10.7	240	342	-0.21	5

Sources
5-CSU Bakersfield, unpulished data, Guler, 2002
10-Fournier and Thompson, 1980
12-Houghton, 1994
25-Sotdick, 1997
29-Whelan et al.,1989
Coso, 2007, personal communication, 2007
GeoTrans, 2004 Report to Coso

C4.1 Introduction

The reader is advised that the following hydrologic impact monitoring program is based on and contains many references to the hydrology impact analyses contained in the Hay Ranch Water Extraction Project Draft Environmental Impact Report (EIR). The reader is urged to read section 3.2 Hydrology and Water Quality in the EIR prior to reading this hydrologic monitoring and mitigation plan (HMMP).

This monitoring plan has been prepared in order to define monitoring of project activities to prevent potential off-site impacts of the proposed project on groundwater and surface water users in the Rose Valley. This plan also describes the methods to prevent a significant effect to ground and surface water users.

The first section of this plan includes the summary of hydrologic impacts and mitigation, as described in detail in the EIR. The second section of this plan describes the HMMP implementation methods.

This HMMP is designed to:

- Define methods for monitoring changes in groundwater levels throughout the Rose Valley;
- Compare observed changes to predicted changes and adjust model predictions as needed during the early operation of the project before any impact is predicted at Little Lake under the current model assumptions;
- Collect groundwater and surface water level data at Little Lake during the same early stages to develop time-trend water level data on Little Lake and to correlate the groundwater levels to Lake levels;
- Monitor later-stage groundwater and lake level changes as groundwater pumping continues;
- Recalibrate the numerical model developed for the project using data collected during the early stages to check and improve the model's ability to simulate stressed (pumping) conditions and to make predictions of future changes in groundwater levels and lake levels in response to pumping; and
- Facilitate the implementation of the mitigation measures defined in the EIR to avoid or reduce impacts to groundwater levels and lake levels before the impacts become significant.

Groundwater elevations and lake water levels are also influenced by natural factors beyond the effect of this project. These factors include rainfall in Rose Valley, snowfall in the Sierra Nevada Mountains, and seismic events that change the geomorphology of surface hydrological features or subsurface permeability. This monitoring and mitigation plan is not designed to mitigate naturally occurring changes in the hydrological system.

C4.2 Summary of Hydrologic Issues

C4.2.1 OVERVIEW

The Coso Operating Company, LLC (COC) is seeking a 30-year Conditional Use Permit (CUP No. 2007-003) from the Inyo County Planning Commission for the Coso Hay Ranch Water Extraction and Delivery System project.

The proposed project includes extracting groundwater from two existing wells on the Coso Hay Ranch, LLC property (Hay Ranch) in Rose Valley and delivering the water to the injection well distribution system at the Coso Geothermal Field in the northwest area of the China Lake Naval Air Weapons Station (CLNAWS). The proposed project is needed to provide supplemental injection

water to the Coso Geothermal Field to minimize the annual decline in reservoir productivity due to evaporation of geothermal fluids from plant cooling towers. The project location is shown in Figure C4-1.

The Inyo County Planning Department (County) has prepared a Draft EIR pursuant to the California Environmental Quality Act (CEQA) to aid in the decision whether or not to issue the CUP. The Draft EIR assesses the potential impacts of the project on the environment.

Evaluation of the hydrological system within Rose Valley suggests that the project as proposed, which includes groundwater pumping at a rate of 4,839 acre-ft/yr for 30 years, may lower the water table elevation and groundwater flow rates in the valley (see Section 3.2 Hydrology and Water Quality of the EIR). If groundwater levels fall significantly in the southern end of the valley, the groundwater flow and surface water levels in the perennial but manipulated Little Lake may be affected, as well as several local wells. The magnitude of change in groundwater level and flow will vary depending on:

- Distance from the pumped well at Hay Ranch
- Magnitude and duration of pumping
- Manipulations at the Little Lake weir

Predictions of the effects of groundwater extraction associated with the project also depend on various assumptions of aquifer properties, boundary conditions, and aquifer recharge.

C4.2.2 PUMPING TEST AND COMPUTER MODELING RESULTS

Many sources of information on local and regional hydrology and geohydrology were used to evaluate aquifer properties and identify groundwater conditions during preparation of the EIR. Consultants for the Coso Operating Company (COC) previously performed short term (24 hour) groundwater pumping tests and conducted computerized hydrologic modeling for the proposed project. These studies have been reviewed and used as appropriate to describe the environmental setting and to analyze the project impacts. During preparation of the project EIR, COC conducted a long-term (14 day) pumping test. Consultants to Inyo County subsequently used the data from the long-term pumping test to evaluate aquifer properties and to recalibrate and refine the computerized hydrologic model developed for COC. The 14-day groundwater pumping test was conducted in the Hay Ranch south well.

Groundwater levels were monitored throughout Rose Valley for a 20-day period before, during, and after the pumping test. In addition, groundwater discharge from the Davis spring at Portuguese Bench was measured during the pumping test. The well pumping lowered groundwater levels up to 0.4 ft in wells at Coso Junction, approximately two miles south of the pumped well, but, not surprisingly given the limited duration of the pumping, it had no discernable effect on groundwater levels in wells on Navy property 5 to 7 miles south of the pumped well, or in a well located at the north end of the Little Lake Ranch property, 8 miles south of the pumped well. Minor changes observed in the groundwater discharge rate from the Davis spring at Portuguese Bench during the test did not appear to be correlated with the pumping test. The pumping test is described in Appendix C1 of the Draft EIR.

Figure C4-1: Project Location

The groundwater drawdown data obtained during the pumping test from the Hay Ranch north well and other wells close to Hay Ranch, as well as hydrogeologic information from several sources, were used to recalibrate a computerized groundwater flow model previously developed to evaluate groundwater conditions in Rose Valley (Brown and Caldwell, 2006). The recalibrated groundwater flow model consists of four layers, including one unconfined (water table) layer, and three confined layers. The model was used to analyze potential long-term effects of the proposed groundwater pumping at Hay Ranch.

The results of the groundwater flow modeling indicated that the principal impact in Rose Valley from operation and maintenance of the Hay Ranch groundwater extraction project will be the propagation of groundwater table drawdown off the property as a result of removing groundwater on the Hay Ranch property and transporting it outside the Rose Valley groundwater basin (to the Coso geothermal field). Numerical groundwater flow modeling analysis was conducted to evaluate potential impacts of project operation on groundwater levels in the Rose Valley. The model setup, calibration, and prediction simulations are described in Appendix C2 of the EIR.

The groundwater flow modeling predicts that groundwater table drawdown will increase with time after pumping begins at Hay Ranch. The modeling predicted that less drawdown will be observed farther away from the pumped wells, as expected based on groundwater flow theory. After pumping is stopped, groundwater levels near Hay Ranch will soon begin to rise back to pre-project levels; however, depending on the magnitude and duration of pumping at Hay Ranch, groundwater levels at the south end of the valley may continue to decline in elevation even after pumping at Hay Ranch has stopped before they also begin to rise back to pre-project levels.

Proposed pumping at a rate of 4,839 acre-ft/yr for 30 years is predicted to cause a maximum groundwater table drawdown of:

- 25 to 55 ft in wells in the Dunmovin community and LADWP wells located 1.5 miles north of Hay Ranch
- 20 to 50 ft in wells at Coso Junction 2 miles south of Hay Ranch
- 5 to 20 ft near the Cinder Road Red Hill well 6.5 miles south of Hay Ranch
- 3 to 11 ft at the north end of Little Lake at the south end of the valley, 9 miles south of Hay Ranch

The range in predicted drawdown impacts listed above reflects uncertainty in assumed values for aquifer specific yield. Low specific yield values result in greater and earlier the drawdown, while higher specific yield values result in less drawdown with time and less drawdown farther from the pumped wells. Published values of specific yield (Johnson 1967, Morris and Johnson 1967) range from 2 % for clay to 35 % for well-graded gravels, in unconfined (water table) conditions. Groundwater-yielding sediments encountered in Rose Valley consist primarily of sand and gravel interbedded with clays; most of the groundwater would come from the more readily drainable sand and gravel horizons. Because specific yield could not be determined from the pumping test data, a range of values corresponding to high, medium, and low values of 30, 20 and 10% were used in the project development impact analyses. The model results were particularly sensitive to the value used for specific yield, because that value is a measure of the change in water level in the aquifer per unit of groundwater that is pumped.

Groundwater modeling also indicates that the amount of drawdown is directly related to the amount of withdrawal. For example, assuming 20% specific yield and pumping for 30 years, predicted drawdown at the north end of the Little Lake ranges from approximately 1.2 ft at an extraction rate of 1,500 acre-ft/yr to approximately 3.2 ft at an extraction rate of 4,000 acre-ft/yr. The predicted change in drawdown is roughly linearly proportional to the project pumping rate; that is, pumping at 3,000 acre-ft/yr has roughly twice the impact of pumping at 1,500 acre-ft/yr.

Several springs located in upland portions of Rose Valley including the Davis Spring at Portuguese Bench, and the Tunawee Canyon Spring in Tunawee Canyon, and the Rose Spring near Haiwee Reservoir. They are sustained by mountain-front recharge in the Sierra Nevada Mountains or seepage from Haiwee Reservoir or Owens Valley. These springs are located at significantly higher elevations and are unlikely to be impacted by the project; therefore, they will not be monitored during project operation.

C4.2.3 DEFINITION OF SIGNIFICANT IMPACTS TO LITTLE LA E AND SURFACE WATERS

The EIR identifies that the project would have a significant impact if it would substantially reduce the amount of water available to surface water bodies at Little Lake Ranch and to other areas in the Rose Valley. A substantial reduction in the amount of water available at Little Lake is defined as greater than 10% reduction in water flowing into the surface features at Little Lake.

Defining thresholds of significant effects to the environment by attempting to measure or predict those effects on vegetation around Little Lake Ranch was considered and rejected. The Little Lake area is highly manipulated. Little Lake is a reservoir, whose level is manually controlled. The vegetation surrounding the area south of Little Lake is manipulated by removal of undesirable species, planting of others, and by moving water to various areas where managers intend to promote vegetation. As a result, there is no natural background condition against which to measure effects. Additionally, by moving water around the property, vegetation may be encouraged in areas not currently highly vegetated and discouraged in areas now heavily vegetated if management objectives for the restoration project shift. Therefore, by necessity, it is most appropriate to emphasize measuring impacts to the amount of water that is available to the restoration project, rather than biological indicators.

C4.2.4 MITIGATION MEASURES DEFINED IN THE EIR

Summary of Impacts and Mitigation

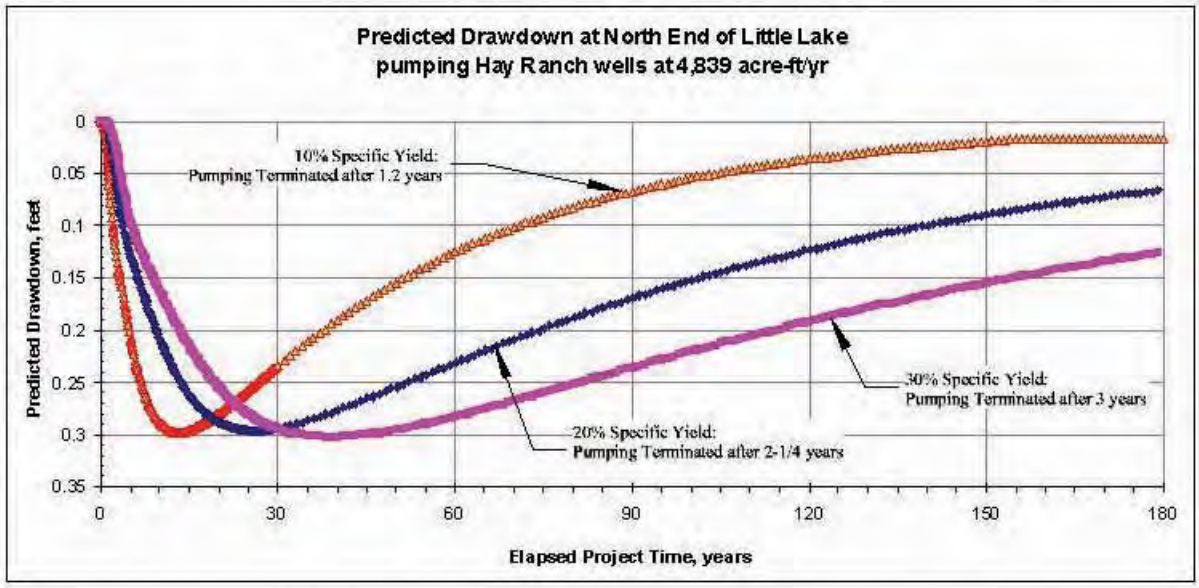
The existing groundwater model predicts that, with a specific yield value of 10%, the project as proposed (pumping at a rate of 4,839 ac-ft per year for 30 years) would have a significant impact on Little Lake (refer to Section 3.2 Hydrology and Water Quality in the EIR).

In order to prevent a significant impact to Little Lake and surrounding surface waters, water inflow to the lake must not decrease by more than 10% of the baseline flow. Data from Bauer (2002) indicates that the historical groundwater elevation at the north end of Little Lake was consistently 3 feet higher than the lake level; because groundwater flow is proportional to the hydraulic head gradient, a 0.3 foot decrease in the groundwater represent a 10% decrease in gradient, and is estimated to correlate to a 10% reduction in discharge of groundwater to Little Lake.

A maximum of 10% reduction in groundwater inflow to Little Lake (this is currently benchmarked to a drawdown of 0.3 feet in the Little Lake North Dock well) would occur following pumping at Hay Ranch at proposed pumping rates for a period of approximately 1.2 years (see Figure C4-2). The model predicts that this maximum drawdown would occur as much as 30 years after the cessation of pumping at 1.2 years, due to the large distance (9 miles) from the pumping.

Mitigation, therefore, allows initiation of pumping for the project at the proposed project pumping rate, until drawdown trigger levels are reached at one or more monitoring locations throughout the valley (Table C4-1). Model predictions indicate that the trigger levels could be reached with pumping occurring in as little as 1.2 years; however, some conservative assumptions that are built into the model may extend this pumping period considerably longer, if actual decreases in the groundwater level occur more slowly than predicted. The trigger points have been established

Figure C4-2: Early Pumping Termination (1.2 years) Scenario Results



using the model to prevent a greater than 10% decrease in flows to Little Lake from ever occurring. Monitoring should occur monthly for at least two years, with results reported to the County within 2 weeks of data collection. After two years, if water levels are decreasing more slowly than predicted, the applicant can petition the County to reduce the measurement frequency to quarterly.

Data collection in the first few months to years would lead to a better understanding of the relationship between pumping at Hay Ranch and groundwater table drawdown throughout Rose Valley and at Little Lake. Data to be collected includes: water level data over time to establish background levels; response of water levels to pumping that will be used to evaluate specific yield and hydraulic conductivity; lake level data; groundwater level data adjacent to Little Lake; and other data needed to re-calibrate the groundwater flow model. These and other data that will be collected are specified in Subsection C4.3.3 and Table C4-2. Pumping may continue as long as the project does not result in a significant decrease in groundwater available at Little Lake at any point in time.

Within approximately 1 year of initiation of pumping, or less if trigger levels are reached sooner, the groundwater flow model should be recalibrated to the observed drawdown in groundwater levels, to allow for more accurate estimation of how long the pumping can continue without exceeding drawdown trigger levels and causing a significant reduction in water available to Little Lake, the springs, and wetlands. A qualified person approved by Inyo County Water Department, and provided by the applicant, would evaluate the results of the first year of data collection, would recalibrate the model, and working with the Inyo County Water Department and the applicant would estimate the duration of pumping that would keep impacts below the defined trigger levels. Recalibration of the model would also be necessary later, if pumping continues significantly longer than 1.2 years, as needed and appropriate to help understand the timing and magnitude of future drawdown of groundwater levels throughout the valley. A maximum limit of 10% groundwater inflow reduction to Little Lake has been selected, to avoid a significant effect on Little Lake. The computer groundwater flow model was used to define equivalent maximum acceptable drawdown levels, (maximum water level drawdown values) at various points up the valley that cannot be

exceeded at any point in time. Water level drawdowns that were maintained below those maximum acceptable drawdown levels would, based on model results, avoid a depletion of groundwater inflow to Little Lake of more than 10%. The model was used to identify corresponding "trigger levels, water level drawdowns at earlier points in time, that would eventually lead (under continued pumping) to reaching the maximum acceptable drawdown levels, at each monitoring point. Requiring that observed drawdown values over time be kept below these defined trigger levels would provide an early warning system, allowing for the system operations to change, to reduce or stop pumping before maximum acceptable drawdown levels propagated down the valley to Little Lake.

Exceedance of predicted groundwater drawdowns (**trigger levels**) at two or more locations in Rose Valley, or exceedance of a **maximum acceptable drawdown level** at any location, would be a cause for action as determined by the County, including re-calibration of the model and potential reductions or cessation of pumping. See Table C4-1 for trigger levels and maximum acceptable drawdown levels.

Table C4-1: Drawdown Trigger Levels (in feet)

Pro ect Elapsed Time, years	Dunmovin Area well	Pumice Mine well	Hay Ranch Observation well	Coso Ranch North well	Coso Junction 1 well	Navy G-36 well	Navy Lego well	Red Hill Cinder Road well	Navy 18-28 well	Little Lake Ranch North well
	Distance from Hay Ranch South Well feet									
		1	*1 3*		*1*	*2*	*2 3*	*32*	*3*	*42*
0.25	0.2	0.5	3.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
0.5	0.3	1.3	4.7	0.4	0.3	0.2	0.2	0.2	0.2	0.2
0.75	0.7	3.3	8.1	0.9	0.7	0.2	0.2	0.2	0.2	0.2
1	1.1	5.3	11.5	1.4	1.2	0.2	0.2	0.2	0.2	0.2
1.2	1.5	6.9	13.2	1.8	1.5	0.2	0.2	0.3	0.2	0.2
1.25	1.6	7.1	11.8	1.9	1.6	0.2	0.2	0.3	0.2	0.2
1.5	1.9	7	7.9	2.1	1.8	0.2	0.2	0.3	0.2	0.2
1.75	2.1	6.5	6.9	2.3	2	0.3	0.3	0.3	0.2	0.2
2	2.3	6	6.2	2.4	2.1	0.3	0.3	0.4	0.2	0.2
3	2.7	4.8	4.8	2.5	2.2	0.5	0.4	0.4	0.2	0.2
4	2.8	4.1	4	2.5	2.2	0.6	0.6	0.5	0.2	0.3
5	2.7	3.6	3.5	2.4	2.2	0.7	0.7	0.6	0.3	0.3
Maximum Acceptable Drawdown in feet)	2.8	7.2	13	2.5	2.3	1.1	1.1	0.7	1	0.4
Time to Max drawdown years since pumping began)	4	1.3	1.2	3	3.5	14.5	15	12	22	13

NOTES

1) For any wells where predicted drawdown is less than or equal to 0.25 feet, actions related to these trigger points shall not be enforced, unless the drawdown seen in these wells is greater than 0.25 feet. Drawdown values of 0.25 feet are difficult to accurately detect.

2) Based on current groundwater flow model results, these maximum drawdown values listed above result from pumping the Hay Ranch production wells at design rates for 1.2 years, with specific yield values of 10%. These maximum acceptable drawdowns can occur several years after pumping at Hay Ranch ceases.

Mitigation Measures from EIR

The following mitigation measures have been defined in the EIR to reduce potentially significant impacts to water users in the Rose Valley. Note that references to Appendix C4 are included in the measures since these measures are taken directly from the EIR. This HMMP is Appendix C4 of the EIR and references are included in the sections of this document.

Hydrology-1: The project applicant shall finalize and implement the Draft Hydrological Monitoring and Mitigation Program (HMMP) included in Appendix C4 this appendix of this EIR.

Hydrology-2: Mitigation for effects to groundwater wells in Rose Valley shall depend upon the specific characteristics of each well, and the use of the well. The applicant shall use monitoring data and the numerical groundwater flow model described in Appendix C2 to track groundwater levels throughout the valley. The applicant shall work with the County Water Department to identify wells that may be affected by groundwater drawdown as the project progresses. The evaluation of wells depths and uses in the Rose Valley as compared with groundwater drawdown shall be made semi-annually and reported to the Inyo County Water Department. The owner of any wells that may potentially be impacted within the six months after an evaluation shall be contacted by the applicant to assess the need for additional pumping equipment on the well or deepening of the well. The applicant shall be responsible for the cost of equipping or deepening wells that are impacted by groundwater drawdown as a result of the proposed project. The applicant shall also evaluate any wells that are brought to the attention of the applicant by the user to evaluate if groundwater drawdown from the proposed project is impacting the well. If it is determined by the County or by the applicant (using well monitoring data and modeling) that the well in question is being impacted by the proposed project, the applicant shall fund the necessary adjustments to the well to secure the previous uses of the well. Disputes as to the cause of well water drawdown or appropriate corrective measures shall be resolved by the County.

Hydrology-3: Monitoring shall occur at a frequency that is sufficient to detect important changes and trends in water levels. Monitoring shall occur monthly, at a minimum, at all monitoring points, following project start-up. The data shall be collected and analyzed by a qualified person approved by Inyo County Water Department and provided by the applicant. Monitoring reports shall be prepared by the applicant and submitted to Inyo County Water Department within 20 days of data collection. After two years, monitoring shall occur quarterly. Reports shall also be provided to a designated recipient at Little Lake Ranch, Inc. A complete list of monitoring locations, parameters, and schedules is presented in Appendix C4 this appendix , Tables C4-1 and C4-2. Hydrologic monitoring locations are shown on Figure C4-2, in Appendix C4 this appendix . Two new monitoring well clusters, each with three wells with screened intervals at three different depths, located approximately 700 feet south of the Hay Ranch North Wells, and 700 feet south of the South Well, respectively, shall be installed by the project applicant, and as approved by the Inyo County Water Department. An additional new water table monitoring well shall be installed by the applicant and as approved by Inyo County Water Department, approximately midway between Coso Junction and the Cinder Road Red Hill well, to provide additional monitoring capability in this area.

The monitoring program also includes reassessment of model-predicted impacts and recalibration of the groundwater model by a qualified person approved by the Inyo Count Water Department, and provided by the applicant. After a period of one year of pumping, observed groundwater level changes shall be compared with predicted groundwater-level changes in order to assess the accuracy of the model-predicted drawdown. If the observed water level changes at two or more of the selected monitoring points differ from predicted values (trigger levels) at those locations by at least 0.25 feet at any point in time, or a maximum acceptable drawdown is reached at a designated monitoring point, or as judged appropriate by Inyo County Water Department, the model shall be recalibrated and the predicted impacts to groundwater levels re-forecast with the recalibrated model. If the model results change with recalibration, the mitigation strategy shall be updated in response to

new forecasts of potential impacts to groundwater, potentially including reducing the duration or rate of pumping, or other mitigation measures as described in the HMMP. Additional recalibration is expected to be needed after one year, as monitoring continues and water level changes are detected farther down Rose Valley. Additional recalibration of the model shall be conducted as appropriate following the criteria outlined above (i.e. if the predicted water level in two or more wells differs from observed water level drawdown by at least 0.25 feet or more, or one or more maximum acceptable drawdown levels in wells all across the valley are exceeded).

Because surface water bodies at the Little Lake Ranch property are likely sensitive to changes in groundwater elevation and groundwater flow rate, the monitoring plan also identifies trigger levels that indicate when a significant impact (defined as a substantial reduction in water to Little Lake) will likely occur unless mitigation measures are implemented to reduce the pumping rate and/or duration of pumping. The plan includes the implementation of mitigation measures (namely, Hydrology-2 and Hydrology-4) to reduce any potentially significant impacts to less than significant levels.

Hydrology-4: The applicant shall be allowed to pump the project at the full proposed pumping rate until a time when and if the predicted groundwater drawdown trigger levels are exceeded at two or more of the designated Rose Valley monitoring points by at least 0.25 feet, or if a maximum acceptable drawdown level is exceeded in any monitoring point.

During the first year, a qualified person, approved by Inyo County Water Department and provided by the applicant, shall conduct the studies described in Hydrology-1 and Appendix C4 of this EIR in order to recalibrate the groundwater model to the early groundwater data. The groundwater model shall be recalibrated in order to more accurately understand the relationship between groundwater pumping, reduction in groundwater elevations across the valley, and availability of water at Little Lake. Pumping rates and duration of pumping shall be determined based on the results of the model and the observed water table drawdown. At no time shall projected results of pumping result in a greater than 10% decrease in groundwater inflow to Little Lake (estimated to be equivalent to a 0.3-foot drawdown in groundwater head at the northern end of Little Lake) unless new data collected in the vicinity of Little Lake indicates that a larger decrease of head would not result in a greater than 10% decrease in groundwater inflow to Little Lake or substantially deplete the water availability to the springs and wetlands (as defined in the Hydrologic Mitigation Monitoring Plan in Appendix C4 of this EIR this appendix).

The revised pumping rate and duration shall be approved by the Inyo County Water Department. The recalibration shall occur within one year after project startup to ensure adequate time is available to make adjustments to the pumping schedule if necessary, to ensure significant impacts do not occur. The model shall be calibrated to the new drawdown data collected since project startup. Based on the results of the recalibrated model, a revised schedule for pumping and revised trigger levels shall be determined that will not be expected to cause a greater than 10% decrease in groundwater inflow to Little Lake. A revised plan for pumping rate and/or duration of pumping shall be submitted with full documentation to the Inyo County Water Department by the end of the first year of pumping. Pumping can continue as long as trigger levels in designated monitoring points that prevent a significant impact are not exceeded, and other signs of substantial impact on surface water bodies (Little Lake, springs, and wetlands) are not observed, as determined by a qualified person approved by Inyo County Water Department provided by the applicant.

An alternative option to minimize impacts to Little Lake could include pumping for one or more years at full scale and model recalibration as prescribed above; however, then reducing pumping to a lesser degree and/or allowing pumping for a longer period of time along with implementing a groundwater diversion plan at Little Lake. The diversion system would include additional pumping from an existing well at the Little Lake Ranch property, if feasible, or construction of a new well. Water would be piped from the well location along existing unpaved roads to the lake where it would be discharged. Water would be withdrawn at the minimum rate necessary to sustain water availability to Little Lake and the lower pond areas. The pumping amount and duration for a water diversion at Little Lake would be

determined by a qualified person approved by the Inyo Count Water Department, and provided by the applicant, based on the recalibrated model. The diversion plan is further described in Appendix C4 this appendix . Diversion would only be effective and implementable to minimize effects to less than significant levels if it were:

- Feasible given the availability of water at Little Lake and would not result in impacts to existing springs (e.g. Coso Spring)
- Agreed upon with Little Lake Ranch and the applicant
- Funded by the applicant
- Required for a reasonable timeframe (i.e., 20 years) that ensured accountability and funding by the applicant to mitigate all effects

If any of the above criteria are not met, then pumping would be scaled back or terminated based on model recalibration as previously described. If determined feasible, the applicant shall use biological and archaeological monitors during all ground disturbance activities associated with the construction of the augmentation plan components. The applicant shall also be responsible for obtaining any required permits for the diversion plan at the time that it is designed and implemented.

C4.2.5 GOALS AND OBJECTIVES OF THIS HMMP

A number of goals and objectives provide the framework for the HMMP, and form the basis for any future decisions regarding the HMMP needed to reflect an evolving understanding of the hydrologic and biologic systems in the Rose Valley and at Little Lake. The HMMP is designed to:

- Establish an understanding of baseline conditions in the hydrologic systems at Little Lake.
- Identify a system for predicting and mitigating for groundwater drawdown in existing wells in the Rose Valley.
- Identify potentially significant impacts to the hydrology at Little Lake as early as possible, by establishing “early-warning” trigger points, based on observed drawdowns in selected monitoring points and other hydrologic parameters. Early-warning trigger points would indicate potential impacts to wetlands and surface waters well in advance of actual, significant impacts.
- Redefine pumping rates and duration of pumping for the long-term project during the period of no effects to Little Lake through recalibration of the groundwater model based on data collected during the early phases of project development.

C4.3 HMMP Implementation

C4.3.1 HMMP IMPLEMENTATION RESPONSIBILITIES AND SCHEDULE

The monitoring and mitigation described in this HMMP will be performed by COC. COC will report results to the Inyo County Water Department on a monthly basis, and within 20 days of data collection. In addition, COC will submit quarterly and annual reports to the Inyo County Water Department summarizing the changes observed during the year and cumulative changes of the entire monitoring period, including conclusions and recommendations evaluating those changes relative to natural conditions such as rainfall and snowfall, assessing the significance of any changes compared to threshold levels if any, documenting any additional hydrologic modeling or adjustments to model-predicted impacts, and documenting any mitigation measures taken with respect to private wells or changes in Hay Ranch extraction rates. Data will also be provided to a designated contact at Little Lake Ranch, LLC.

C4.3.2 INYO COUNTY CODE CHAPTER 18.77 PROTECTIONS

It should also be noted that COC is subject to all regulations as stated in the Inyo County Code, Chapter 18.77.045 and 18.77.055, which allows for the CUP to be challenged at any time if conditions of the permit are not being implemented or pumping is proven to be "causing unreasonable effect on the overall economy or environment of Inyo County." The permit could be modified or revoked as a result. Conditions of the code also help to minimize the potential for potentially significant impacts associate with the project. The final decision on any modifications to the CUP shall be in compliance with the Inyo County Code.

The Planning Commission may *revoke* the CUP if it finds that the water transfer can not be conducted without having an unreasonable effect on the economy or environment of Inyo County, regardless of the implementation of this HMMP.

C4.3.3 MONITORING PHASES

Four distinct monitoring phases will be implemented:

Phase 1: Monitoring System Setup and Supplemental Data Collection

Phase 2: Startup Monitoring and Reporting

Phase 3: Model Recalibration and Redefinition of Pumping Rates and Durations; and,

Phase 4: Ongoing Monitoring, Mitigation, and Reporting

Monitoring system setup consists of several tasks that will be completed concurrent with construction of the project, including the following:

- Installation of two new monitoring well clusters on the Hay Ranch property;
- Installation of one new monitoring well between Coso Ranch and the Cinder Road Red Hill well; and
- Surveying proposed monitoring locations and elevations to establish the baseline conditions.

Startup monitoring comprises monitoring undertaken during the first 1.25 years of operation of the project. Model recalibration would occur within the first year and would be used to determine future pumping rates and duration to minimize impacts to Little Lake. Ongoing monitoring comprises monitoring conducted throughout the life of the project.

Phase 1: Monitoring System Setup and Supplemental Data Collection

Monitoring system setup comprises various tasks designed to:

- Establish monitoring facilities and benchmarks to establish prevailing conditions prior to generating impacts and to establish the monthly baseline levels from which to compare the trigger level drawdown values in Table C4-1;
- Prepare supplemental engineering plans to specify a point of contact and mitigation measures to mitigate impacts to private wells (which may include deepening wells, changing pumping equipment, or compensating well owners for increased electricity costs for pumping);
- Collect supplemental data to address data gaps identified during preparation of the EIR, necessary for recalibration of the groundwater model; and
- Conduct supplemental engineering studies to evaluate the feasibility of extracting groundwater on the Little Lake Ranch property to augment water levels in the lake, and preparation of engineering plans to implement water diversion, if pursued at a later date.

Task 1.1: Monitoring System Setup

Monitoring system setup will include the tasks listed below. Existing wells that will be used for monitoring are shown on Figure C4-3. Proposed wells are described in the text, below.

a. Completing two new monitoring well clusters on the Hay Ranch property. The northernmost new well cluster location will be completed approximately 600 to 800 feet south of Hay Ranch North well, between the two existing wells. The second well cluster will be located approximately 600 to 800 feet south of Hay Ranch South well. Each well cluster will consist of: one shallow well screened across the water table, with the screen extending from approximately 10 feet above the current water table to approximately 100 feet below the current water table (i.e., approximately 190 feet to 290 feet bgs); an intermediate depth well screened from approximately 350 to 400 feet below ground surface (bgs); and a deep well screened from approximately 500 to 550 feet bgs.

   The purpose of the well clusters will be to provide access points for measuring groundwater drawdown on the Hay Ranch property outside of the pumped wells, so that groundwater drawdown at various depths can be assessed and aquifer parameters such as specific yield, storativity, and hydraulic conductivity can be evaluated. Because of well losses, drawdown measurements in the pumped wells themselves do not provide reliable information regarding water table drawdown in the aquifer.

b. Installing one new monitoring well approximately midway between Coso Junction and the Cinder Road Red Hill well. The well should be installed to intersect the water table, with a screen located approximately 10 feet above and 50 feet below the current water table.

c. Establishing access agreements, if possible, to monitor the Red Hill well on Cinder Road, one or more wells in the Dunmovin community, and two or more wells on the west side of Haiwee Reservoir approximately 7 miles south of Olancha (tentatively identified as the McNalley, Toone, Dews, or Buckland wells).

d. Installing pressure transducers and electronic data loggers in the six newly constructed Hay Ranch monitoring wells and the Little Lake North Dock well, to measure groundwater level, and in Little Lake to measure lake level. If the currently unused Little Lake Hotel well is found to be pressurized (artesian) then a pressure gauge should be installed on the well head; otherwise a reference point for manual water level measurements should be established.

e. Installing and calibrating flow measurement weirs at the discharge from Little Lake and at the North Culvert location previously used by Bauer (2002) to measure combined discharge from Little Lake, Coso Spring, the Little Lake siphon well, and the two perennial ponds (P-1 and P-2) on the Little Lake Ranch property.

f. Surveying the locations and casing elevations of wells added to the monitoring network at Hay Ranch, Dunmovin, Enchanted Lake Village, Red Hill, Fossil Falls, Little Lake Hotel, and Little Lake North Dock wells and any other designated monitoring points in Rose Valley where elevations are uncertain. Also, to be surveyed are the locations and elevations of surface water features on the Little Lake Ranch property including a reference point for Little Lake water level; base and adjustment points for Little Lake weir; Coso Spring; the siphon well head and discharge point; ponds P-1 and P-2; and, the North Culvert weir.

g. Evaluating existing well pump depths at Dunmovin, Coso Junction and Red Hill wells. The owners will be contacted to assess current pump depth and performance.

h. Preparation of required and optional supplemental engineering plans primarily consists of two tasks:

   – (Required) Establishment of a private well mitigation plan that would include a single point of contact for each well for resolving issues with respect to possible project impacts on existing private wells in the valley; identifying suitable qualified contractors to address issues such as pump deepening or replacement, or well deepening; putting a process in place to pay for such work.

Figure C4-3: Existing Wells that will be used in Hydrologic Monitoring

SOURCE: Geologica 2008

LEGEND

- ▲ Spring or Siphon Well
- ● Pumping Well
- ○ Out-of-Use Well

Approximate Scale in miles

0 1 2

MHA ENVIRONMENTAL CONSULTING An RMT Business

- (Optional) Preparation of a groundwater diversion plan for Little Lake capable of providing water to augment water levels in the lake. As discussed in Section C4.1.4, this plan would only be prepared and implemented if Little Lake Ranch agreed to this diversion, adequate groundwater was documented to be available on the Little Lake property, the diversion could be conducted for a reasonable time frame (i.e. no more than 20 years), and the applicant agreed to fund the diversion. This would include an evaluation of existing wells at the Little Lake Ranch property to assess their potential yield, location relative to the lake, pump, piping and electrical needs, and lift requirements. The plan would then include tentative specifications for well construction, if needed, pump, piping, electrical work, controls, and flow meters as well as an assessment of permitting requirements and likely lead times for construction and permitting.

i. **Establish background groundwater levels**. Establishing a pre-pumping statistical background water level for each designated monitoring point is essential, in order to distinguish between natural seasonal variability versus drawdown caused by pumping associated with the project. Establishing a background for each monitoring point will require pre-pumping measurements to be conducted for a sufficient period of time to encompass normal seasonal variations in water level.

   A minimum of 6 months of water level data will be required to establish the background water level at each monitoring point, and it is recommended but not required that 12 months of data be collected. The applicant shall conduct statistical evaluation of the background water level data by a qualified person approved by Inyo County Water Department and provided by the applicant. An appropriate statistical method to calculate the background water levels shall be proposed by the applicant, subject to approval by Inyo County. Upon approval, the background water level for each monitoring point shall be calculated by the applicant and presented to Inyo County Water Department for review and approval. It is anticipated that statistical methods similar to those used to calculate background concentrations of naturally occurring chemical constituents at RCRA and CERCLA sites may be applicable.

Task 1.2: Supplemental Data Collection and Evaluation

Supplemental data evaluations comprise the following tasks:

a. Evaluate groundwater levels beneath Little Lake, by installing temporary mini-piezometers to a depth of approximately 3 feet or more beneath Little Lake, at a minimum of four locations (for mini-piezometer and potentiomanometer details, see Wantry, R. and T.C. Winter, 2000). A Simple Device for Measuring Differences in Hydraulic Head Between Surface Water and Shallow Ground Water. U.S. Geological Survey Fact Sheet FS-077-00. June 2000). Measure the water levels relative to lake level, to evaluate the magnitude of the hydraulic gradient into or out of the lake, at four or more locations situated around the lake to obtain a representative evaluation of the hydraulic gradient between Little Lake and the underlying groundwater, prior to startup of the wells at Hay Ranch. Conduct measurements at the same locations for a period of six months prior to startup of the pumping system, to establish the background condition beneath the lake.

b. Depth to bottom and location measured using a hand held GPS unit at approximately 20 locations across Little Lake will be used to develop a preliminary bathymetric survey map.

c. Groundwater samples will be collected at each of the selected monitoring locations in Rose Valley to establish background (pre-pumping) conditions prior to the onset of pumping. The relationship between specific conductivity measured with a hand-held field instrument and total dissolved solids measured in the laboratory (preferably using EPA method 160.1) will also be assessed, for on-going electrical conductivity field measurements to be taken on a quarterly basis (four times/year) at a minimum.

d. Compilation of data on rainfall in Rose Valley (see Coso Hot Spring Monitoring Program 2005-2006, Geologica, 2007) and snow fall in the Sierra Nevada Range for the last 20

years to establish mean values for each and historical trends prior to project startup. These data will be used to assess future changes or trends in the relative level of potential recharge for each monitoring year.

Phase 2: Startup Monitoring and Reporting

Monitoring

The objective of start-up monitoring is to document the response of the aquifer to pumping. Data collected during the start-up monitoring phase will be used to improve estimates of aquifer specific yield, storage coefficients, hydraulic conductivity, and groundwater recharge rates as well as to better understand hydrologic conditions at Little Lake. These monitoring data will be used to validate and/or revise the computerized hydrologic model-predicted impacts long before thresholds of significance are reached. Start-up monitoring will continue for up to two years and includes the locations and parameters identified in Table C4-1 and as defined in Table C4-2, below.

Table C4-2: Hydrologic Monitoring Parameter Summary Rose Valley Hydrologic Monitoring and Mitigation Program

Monitored Location 1)	Parameters Monitored	Monitoring Frequency	Threshold Requiring Action	Action if Threshold Exceeded
Groundwater Level E traction				
Hay Ranch North and Hay Ranch South wells	Total Groundwater Extracted	Daily	Pumpage not to exceed 4,839 acre-ft per year	Reduce or discontinue pumping.
Six New Hay Ranch Observation wells (2 nests of 3 wells)	Groundwater Elevation	Measured hourly at a minimum using dedicated pressure transducer with data downloaded and plotted weekly for the first 3 months, then monthly. Supplement with manual measurements weekly for the first three months, then monthly.	Deviation of observed drawdown in two or more wells is at least 0.25 feet more than predicted trigger level value at any time beyond 4 months.	Alert County. County evaluates whether reduced pumping is appropriate prior to model recalibration. If appropriate, recalibrate model within one month and reassess impact to Little Lake.
			Groundwater level decline in two or more wells exceeding updated model predicted drawdown trigger levels by more than 0.25 feet in any quarterly data collection and monitoring period	Alert County. County to determine if decreased pumping is necessary immediately. Increase monitoring frequency to weekly for one month to confirm observation. Include results as part of quarterly data submittal. Recalibrate model within one month.

Table C4-2 *Continued* : Hydrologic Monitoring Parameter Summary Rose Valley Hydrologic Monitoring and Mitigation Program

Monitored Location 1)	Parameters Monitored	Monitoring Frequency	Threshold Requiring Action	Action if Threshold Exceeded
			Maximum acceptable drawdown level from Table C4-1 exceeded	Pumping ceases until the model is recalibrated and will re-start only if it can be shown that pumping can continue at a rate that will maintain wetlands and water levels at Little Lake Ranch.
Pumice Mine well	Groundwater Elevation	Monthly for first two years, then quarterly	Deviation of observed drawdown at least 0.25 feet from predicted trigger level value at any time beyond the first quarter in two or more wells	Alert County. Recalibrate model within one month. Reassess potential impact to Little Lake. County to evaluate whether reduction in pumping is warranted.
LADWP V816			Groundwater level decline exceeding updated model predicted drawdown trigger levels by more than 0.25 feet in any well in any quarterly data collection and monitoring period	Alert County. Increase monitoring frequency to weekly for one month to confirm observations. Include results as part of quarterly data submittal. Recalibrate model within one month. County to evaluate whether and when a reduction in pumping is warranted.
Dunmovin well				
Coso Junction #1, Coso Ranch North Well				
Lego well				
Well G-36				
Well 18-28				
Fossil Falls Campground well. New well to be located between Coso Jnc and Cinder Road Red Hill well				
Cinder Road, Red Hill well			Maximum acceptable drawdown level from Table C4-1 exceeded	Pumping ceases until the model is recalibrated and will re-start only if it can be shown that pumping can continue at a rate that will maintain wetlands and water levels at Little Lake Ranch.
Little Lake Ranch North well	Groundwater Elevation	Monthly for first two years, then quarterly	Deviation of observed drawdown at least 0.25 feet	Revise trigger level based on Little Lake hydrology study

Table C4-2 *Continued* : Hydrologic Monitoring Parameter Summary Rose Valley Hydrologic Monitoring and Mitigation Program

Monitored Location 1)	Parameters Monitored	Monitoring Frequency	Threshold Requiring Action	Action if Threshold Exceeded
			more than predicted value at any time beyond the first quarter	Reduce or cease pumping at Hay Ranch at the direction of the County. Augment flow to Little Lake in accordance with EIR Section 3.2.3 (Hydrology-3) and implement the Augmentation Plan to maintain groundwater level above trigger level
			Groundwater level decline exceeding updated model predicted drawdown by more than 50% in the well in any quarterly data collection and monitoring period	Alert County. Increase monitoring frequency to weekly for one month to confirm observations. Include results as part of quarterly data submittal. Recalibrate model within one month. County to evaluate whether and when a reduction in pumping is warranted. .
			Maximum acceptable drawdown level from Table C4-1 exceeded	Pumping ceases until the model is recalibrated and will re-start only if it can be shown that pumping can continue at a rate that will maintain wetlands and water levels at Little Lake Ranch.
At least two of McNalley, Toone, Dews, or Buckland wells located west of Haiwee Reservoir	Groundwater Elevation	Monthly for first two years, then quarterly	N/A. Information used to update model	N/A
Haiwee Reservoir	Stage level	Request average weekly values from LADWP	N/A. Information used to update model	N/A
LADWP Aqueduct	Flow rate			
Little Lake Hydrology				
Little Lake Hotel Well and Little Lake North Dock well	Groundwater Elevation (or closed well pressure)	Measured hourly using dedicated pressure transducer	No threshold applied, Information used to update model and	N/A

Table C4-2 *Continued* : Hydrologic Monitoring Parameter Summary Rose Valley Hydrologic Monitoring and Mitigation Program

Monitored Location 1)	Parameters Monitored	Monitoring Frequency	Threshold Requiring Action	Action if Threshold Exceeded
Little Lake	Lake Water Level Elevation	with data downloaded and plotted weekly for the first 2 months, then monthly.	trigger levels.	
Little Lake Weir	Little Lake Weir Discharge and Weir Height(1)			
Little Lake North Culvert Weir	Little Lake System Discharge Rate			
Groundwater beneath Little Lake (minimum of four locations)	Groundwater elevation relative to lake	Monthly for 6 months after startup; then Quarterly		
Little Lake Ranch Pond P1	Occurrence of Siphon Well Discharge	Weekly by visual inspection; discontinue at end of baseline monitoring period		
Little Lake	Major operational changes	Request quarterly reporting of any major operational changes to lake level or groundwater pumping on property.	1 ft or more change in lake level or groundwater pumping on property in excess of 100 gpm daily average	None applicable. Data to be used for model updates, if needed, and for evaluating basin wide groundwater level responses in quarterly data submittal
Groundwater uality				
Hay Ranch North and Hay Ranch South wells	Specific Conductivity/TDS	Quarterly	TDS increase to 2,000 mg/L or greater	Increase monitoring frequency to monthly for 3 months and monitor 18-28, G-36; evaluate basin wide response and determine whether reduction in pumping or supply of alternative water source is warranted
Coso Junction #2, Little Lake Ranch North well	Specific Conductivity/TDS	Quarterly	TDS increase to 1,500 mg/L or greater	Increase monitoring frequency to monthly for 3 months and monitor 18-28, G-36; evaluate basin wide response and determine whether reduction in pumping or supply of alternative water source is warranted

Table C4-2 *Continued* : Hydrologic Monitoring Parameter Summary Rose Valley Hydrologic Monitoring and Mitigation Program

Monitored Location 1)	Parameters Monitored	Monitoring Frequency	Threshold Requiring Action	Action if Threshold Exceeded
Well ield				
Dunmovin wells, Coso Junction wells, Red Hill well, Fossil Falls Campground well	Well Yield	Quarterly	Decrease in yield of 25% or more from pre-startup levels	Mitigate well impacts per EIR Section 3.2.3 (Hydrology-2) and the Private Well Mitigation Plan
Precipitation Recharge				
Little Lake Canyon Precipitation Gauge	Precipitation totals	Daily using continuous recorder	No threshold applicable. Use data to identify basin groundwater level response (west side vs. east side) and mountain vs. valley precipitation for future numerical model updates	Recalibrate model and reassess impact to Little Lake
Haiwee Reservoir Precipitation Gauge				
(1) With the exception of Hay Ranch, every monitoring point is subject to access approval from the appropriate owner.				

Remedial Actions

The following actions are to be taken based on conditions observed during the first year of project operation:

- If drawdown trigger levels predicted **for any point in time** are exceeded in any of the selected monitoring wells, COC shall verbally report the exceedence to the Inyo County Water Department within 48 hrs, followed by a written report within 7 days.
- If drawdown trigger levels predicted **for any point in time** are exceeded in two or more of the selected monitoring points by at least at least 0.25 feet, COC shall verbally report to the Water Department within 48 hrs, followed by a written report within 7 days, followed by a re-calibration of the model and recommendation of cessation of pumping or predictions of the duration of pumping that can be sustained without causing a significant reduction in water available to Little Lake, (defined as no greater than 10% reduction in groundwater inflow); if appropriate, the Applicant may petition the County for permission to continue pumping for a specified duration. The County will evaluate the report and data, and will make a determination as to whether continued operation is appropriate.
- If predicted **maximum acceptable drawdown trigger levels** are exceeded in any of the selected monitoring points located at least 9,000 feet from both Hay Ranch production wells, COC shall: verbally report to the Water Department within 48 hrs; followed by a written report within 4 days; followed by a suspension of pumping within 7 days pending re-calibration of the model; and recommend either cessation of pumping or make predictions of the duration of pumping that can be sustained without causing a significant reduction in water available to Little Lake, (defined as no greater than 10% reduction in groundwater inflow), to be conducted within 4 weeks of the observation of the exceedance. The County will evaluate the report and data, and will make a determination as to whether continued operation is appropriate.
- If measured drawdown values in all monitoring locations at all times within first year of project pumping, match predicted drawdown plots to within 25% or less but are generally below the predicted values, then COC must stop pumping at 1.2 years. However,

they may recalibrate the model before cessation of pumping and use available data collected to date, to petition for a presumably small extension to pumping. The County will evaluate the report and data, and will make a determination as to whether continued operation is appropriate.

- If monitoring data collected during the first year show that a majority of monitoring points record drawdowns are consistently lower than predicted, then COC can re-calibrate the model and make new predictions of the acceptable duration of pumping. Evaluation and correction of background levels for each well shall be conducted to account for natural variation and to separate effects of pumping from natural effects.

The proponent will prepare monthly reports within 20 days of data collection. The monthly reports will include the calculated drawdown amounts for each well monitored. Any well that exceeds its predicted drawdown from the baseline level for the specific month monitored, will be highlighted in the report.

Quarterly reports for submittal to the Inyo County Water Department during the startup monitoring period will also be required. The reports will include tabular summaries and electronic data packages for all monitoring data, and graphical presentations including at a minimum, the following:

- Quarterly groundwater elevation contour maps;
- Quarterly total dissolved solids (TDS) or electrical conductivity contour maps;
- Time versus water level measured in monitoring wells and Little Lake; and
- Time versus Hay Ranch pumping rate, Little Lake discharge, and flow measured at the North Culvert on the Little Lake Ranch property.

The quarterly reports will also discuss any issues such as unexpected drawdown, reduced yield or flow identified with private wells or springs in the valley, or Little Lake. Any measures taken or proposed to mitigate these issues shall be discussed. At the end of the first and succeeding years of operation, if any, the proponent will prepare an annual monitoring report summarizing the findings of the quarterly monitoring reports and evaluating the following:

1) Annual groundwater extraction from Hay Ranch wells;
2) Calculated groundwater table drawdown as measured in designated wells that are monitored in the valley;
3) Evidence for impact to spring discharge and/or surface water flows at Little Lake;
4) Evidence for adverse impacts to water quality based on measured specific conductivity or TDS in springs and well waters;
5) Trends in precipitation data to establish relative “wetness” of the first year of the project based on annual Rose Valley rainfall and Sierra snow fall that might impact recharge, groundwater levels, or spring flow in the valley;
6) Seismic events, major storms, or other unusual events as applicable;
7) Comparison of groundwater levels in wells monitored near Haiwee Reservoir to water levels in wells at the north end of Rose Valley to reevaluate the fixed northern groundwater flow boundary in the numerical model;
8) Reevaluation of the specific yield, storage coefficients, hydraulic conductivity, and groundwater recharge rates of the aquifer and comparison to values used in the numerical model.
9) Evaluation of the observed relationship between Little Lake water elevation and groundwater elevation (or pressure) in Little Lake North and/or Little Lake Hotel wells; and
10) The results of the re-calibration of the model during the first year, and any subsequent re-calibrations, shall be discussed in the annual report.

Phase 3: Model Recalibration and Redefinition of Pumping Rates and Duration

Model Recalibration

Based on the data collected in Phase 2, the numerical groundwater flow model will be recalibrated by a qualified person approved by Inyo County Water Department and provided by the applicant after six to 12 months of data have been collected. The model recalibration effort will include consideration of the following:

- Estimation of aquifer specific yield, storage coefficients, recharge through model boundaries, and any needed changes to the hydraulic conductivity distribution within the model grid to more accurately simulate the actual aquifer response to prolonged pumping at Hay Ranch.
- Evaluation of hydrologic data obtained from baseline studies and monitoring at Little Lake Ranch to reassess the trigger levels for groundwater impacts on Little Lake. Evaluation of the magnitude of the hydraulic gradient from the underlying groundwater into Little Lake.
- Evaluation of correlation between seasonal groundwater level changes at the south end of Owens Valley and groundwater elevation changes in Rose Valley and any other factors deemed significant to reassess the magnitude of groundwater underflow from Owens Valley and/or seepage from Haiwee Reservoir.
- Assessment of precipitation monitoring data to identify basin groundwater level response (west side vs. east side) and mountain vs. valley precipitation.
- Reassessment of geothermal water upwelling rate, which is currently neglected in the model, based on the observed response of wells (G-36 and 18-28) completed on Navy property.

The timeframe for recalibrating the numerical model should be accelerated if observed levels of well drawdown exceed model-predicted drawdown in two or more monitoring points by greater than 0.25 feet over predicted drawdown values, within the first six to eight months of pumping; otherwise recalibration should be conducted between eight and 12 months of project operation. The recalibrated model shall be used to reassess projected impacts to groundwater inflow to Little Lake based on the maximum acceptable drawdown trigger level at Little Lake.

The maximum acceptable drawdown trigger level at Little Lake, set at 10% reduction in groundwater inflow to the lake, is estimated to be equivalent to a drawdown of 0.3 feet in the groundwater at the northern end of Little Lake; this may be revised based on new measurements of pre-pumping groundwater levels near the lake, and on new lake level data. ***Any revisions to trigger levels must be set such that Little Lake surface waters will never e perience a greater than 1 reduction in inflow as a result of the proposed project.***

The recalibrated model will be used to evaluate whether, based on a more accurate simulation of hydraulic conditions in the Rose Valley, project pumping can continue to 1.2 years or longer. The recalibrated model shall also be used to establish new trigger levels for each of the monitoring wells listed in Table C4-1. The new trigger levels will be incorporated into an addendum to this plan, and again, must meet the criteria that Little Lake surface waters will not ever experience a greater than 10% reduction in inflow as a result of the proposed project. The recalibrated model and any modifications to trigger levels must be reviewed and approved by the Inyo County Water Department.

Redefinition of Pumping Rates and Duration

Pumping rates and duration will be redefined by a qualified person approved by Inyo County Water Department provided by the applicant prior to the 1 year project benchmark. Pumping will not be

allowed to proceed beyond the initial year operation period until revised pumping rates and duration are approved by the Water Department.

The revised pumping rates and duration will be set to reduce potentially significant impacts to less than significant levels for the duration of the project until the period of maximum drawdown levels has passed at Little Lake.

Modeling conducted for the EIR indicated the groundwater table at Little Lake could continue to decline as a result of pumping the Hay Ranch wells for up to 30 years after termination of pumping before beginning to rise back to pre-project levels. Consequently, the analysis of revised pumping rates and duration should consider when the maximum groundwater table drawdown will occur, and how much drawdown will occur, to ensure that Little Lake never experiences a greater than 10% decrease in groundwater flow as a result of the proposed project.

Phase 4: Ongoing Monitoring, Reporting, and Mitigation Implementation

Groundwater and surface water monitoring will continue to be conducted during the subsequent years of groundwater production from Hay Ranch, according to Tables C4-1 and C4-2, above.

Groundwater Monitoring and Mitigation Implementation

Groundwater monitoring includes the monitoring of groundwater pumping rates at Hay Ranch, water elevations in designated non-pumped wells through out the valley, specific conductivity and/or TDS, and water levels and pumping rates in pumped wells within the valley as listed in Table C4-1. Groundwater elevations will be compared to the model-predicted levels annually. The need for recalibrating the numerical groundwater flow model should be reviewed for every year of Hay Ranch well pumping (or more frequently if trigger levels are exceeded, as noted previously) to ensure the accuracy of predictions of future water level drawdown.

Groundwater levels in private pumped wells will be monitored using depth to groundwater measurements from designated monitoring points located throughout the valley. When the static groundwater elevation appears to be within 20 feet of the bottom of the well or the well yield is observed to be reduced and further investigation indicates that the water level has dropped too low for an effective pump depth, the well will be remediated by COC by setting the pump deeper, and potentially deepening the well. Some wells may require more powerful pumps to compensate for lower water levels. Mitigation of impacts to private wells will be implemented as described in the Private Well Mitigation Plan, established during the 2 year setup phase (previously described).

Groundwater elevations in Little Lake Ranch well, Little Lake Hotel well, and the North Dock well, and Little Lake water levels and Little Lake discharge rates will be monitored to ensure that trigger levels are not reached for the duration of the project, as determined in Phase 3 Model Recalibration and Redefinition of Pumping Rates and Duration. Mitigation in terms of reduced pumping rates or duration of pumping and/or implementation of a groundwater diversion plan would be implemented as described in Phase 3.

Surface Water Monitoring and Mitigation

Although surface water monitoring will include the Coso Spring and Little Lake, threshold levels triggering mitigation will be focused on Little Lake. The lake water elevation, lake discharge and specific conductivity, spring discharge and specific conductivity, and occurrence of siphon well discharge will be monitored.

If agreed upon by the County, COC, and Little Lake Ranch and determined to be feasible as defined in mitigation measure Hydrology-3, a Little Lake water diversion plan will be developed during project start-up and implemented based on trigger levels throughout the valley. The water diversion plan will include additional pumping from one or more of the existing wells at the Little

Lake Ranch property, if feasible, or construction of a new well. Water will be piped from the well location to the lake where it shall be discharged. Water will be withdrawn at the minimum rate necessary to maintain lake water levels and surface water flows for maintenance of existing plant communities on the property or at the level indicated with updated modeling results.

The applicant will use biological and archaeological monitors during all ground disturbance activities associated with the construction of the augmentation plan components. The applicant will also be responsible for obtaining any required permits for the augmentation plan at the time that it is designed and implemented. The applicant will also be responsible for financing the augmentation plan for the duration that it is determined needed.

Ongoing Reporting

During the Ongoing Monitoring Phase, COC will continue to prepare monthly and quarterly reports.

An annual report will also be prepared for submittal to the Inyo County Water Department. If the Inyo County Water Department approves groundwater extraction at Hay Ranch beyond the initial year, the proponent may petition Inyo County to reduce the reporting frequency for interim reports (i.e. monthly reports). The annual reports will include tabular and graphical summaries of all monitoring data as discussed under Phase 1: Startup Monitoring. The monitoring reports will also discuss any issues identified with respect to potential impacts to private wells in the valley, such as reduced yield or other problems, and will discuss any measures taken to mitigate these issues. On an annual basis, the proponent will prepare an annual monitoring report summarizing the findings of the quarterly monitoring reports and evaluating the following:

- Annual groundwater extraction from Hay Ranch wells;
- Calculated groundwater table drawdown in wells in the valley and comparison to groundwater drawdown trigger levels;
- Evidence for impact to spring discharge and/or surface water flows at Little Lake;
- Evidence for adverse impacts to water quality based on measured specific conductivity or TDS in springs and well waters;
- Trends in precipitation data that might impact recharge, groundwater levels, or spring flow in the valley; and
- Seismic events, major storms, or other unusual events as applicable.

Based on these analyses, the annual reports will discuss the need for mitigating impacts to Little Lake, if any, and discuss any recommended changes to the monitoring plan including monitoring frequency, parameters, or locations.

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APPENDIX I
UltraSystems Biological Survey

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BIOLOGICAL SURVEY

HAY RANCH WATER EXTRACTION AND DELIVERY SYSTEM

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MARCH 2005

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1 INTRODUCTION

1.1 Biological Survey Objectives

The objective of this Biological Survey is to identify the potential affects of the proposed Hay Ranch Water Extraction and Delivery System on plants and wildlife in the project area, including review of the potential affects of the proposed project on special-status species. Special-status species are native species that have been accorded special legal or management protection because of concern for their continued existence. There are several categories of protection at both federal and state levels, depending on the magnitude of threat to continued existence and existing knowledge of population levels. Special-status species include species that are listed as threatened or endangered ("listed species") by either the U.S. Fish and Wildlife Service (USFWS) or the California Department of Fish and Game (CDFG).

The special-status species and sensitive biological resources present, or potentially present, onsite were identified through a literature review using the following resources: the California Native Plant Society's (CNPS) Electronic Inventory of Rare and Endangered Vascular Plants of California,[1] Calflora Database,[2] compendia of special-status species published by CDFG,[3,4] CDFG's California Natural Diversity Database (CNDDB),[5] and the West Mojave Plan Draft EIR/EIS.[6] Ten special-status species potentially occur in the project area. These are shown in Tables 1 and 2.

Biological surveys of the project site were conducted in spring 2004 and January 2005 to review current biological conditions.

1.2 Threatened and Endangered Species Summary

No plant species listed as threatened or endangered potentially occur on the project site. No plant species listed as threatened or endangered are known to occur within the region of the project site.

Two listed animal species, the desert tortoise and the Mojave ground squirrel, potentially occur on the project site. The biology, distribution, and local occurrence of the desert tortoise and the Mojave ground squirrel are described in detail in Section 3 of this report.

The project site was surveyed for desert tortoise and sign of desert tortoise.

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[1]/ California Native Plant Society. 2001. Electronic Inventory of Rare and Endangered Vascular Plants of California (electronic records of sensitive species on the USGS 7.5' Condor Peak Quadrangle). California Native Plant Society, Sacramento.

[2]/ CalFlora: Information on California plants for education, research and conservation. [web application]. 2000. Berkeley, California: The CalFlora Database [a non-profit organization]. Available: http://www.calflora.org.

[3]/ California Department of Fish and Game (CDFG), Natural Diversity Data Base. 2003b. Special Plants. Unpublished report available from CDFG, Natural Heritage Division, Sacramento. January.

[4]/ California Department of Fish and Game, Natural Diversity Data Base. 2003c. Special Animals. Unpublished report available from CDFG, Natural Heritage Division, Sacramento. January.

[5]/ California Department of Fish and Game (CDFG), February 5, 2003. *Rarefind 2: A Database Application for the Use of the California Department of Fish and Game Natural Diversity Base.* Sacramento, CA: California Department of Fish and Game.

[6] Bureau of Land Management, 2003. Draft Environmental Impact Report and Statement for the West Mojave Plan A Habitat Conservation Plan and California Desert Conservation Area Plan Amendment. U.S. Dept. of Interior.

Table 1
SPECIAL-STATUS PLANT SPECIES
POTENTIALLY OCCURRING IN THE PROJECT AREA

Species	Status	Blooming Period	Habitat Associations	
			General	Micro
Charlotte's phacelia *Phacelia nashiana*	FSC CNPS List 1B	March to June	Joshua tree woodland, Mojavean desert scrub, pinyon juniper woodland.	Granitic soils; sandy or rocky areas on steep slopes or flats. 1,970 – 7,220 ft.
Darwin mesa milk-vetch *Astragalus atratus* var. *mensanus*	CNPS List 1B	April to June	Great basin scrub, Joshua tree woodland, pinyon juniper woodland. Known from only a few collections near Darwin, Inyo County.	Dry desert slopes and mesas, often sheltering under and entangled in shrubs, in volcanic clay and gravel. 4,460 – 6,070 ft.
Sanicle cymopterus *Cymopterus ripleyi* var. *saniculoides*	CNPS List 1B	April to June	Joshua tree woodland, Mojavean desert scrub. In California, only known from Inyo County.	On sandy soils, often with carbonate; usually found in Joshua tree woodland or creosote bush scrub. 3,280 – 5,450 ft.
Inyo hulsea *Hulsea vestita ssp. inyoensis*	FSC CNPS List 2	April to June	Pinyon juniper woodland, great basin scrub. In California, known only from Inyo and Mono counties.	In volcanic ash on steep slopes. 5,360 – 9,840 ft.
Pinyon rock cress *Arabis dispar*	CNPS List 2	March to June	Joshua tree woodland, pinyon juniper woodland, Mojave desert scrub.	Granitic, gravelly slopes & mesas. Often under desert shrubs that support it as it grows. 3,940 – 7,870 ft.
Creamy blazing star *Mentzelia tridentata*	CNPS List 1B	March to May	Mohave desert scrub.	2,300 – 3,810 ft.

Key:
FE: Federally Listed as Endangered
FT: Federally Listed as Threatened
FPE: Federally Proposed for Listing as Endangered
FPT: Federally Proposed for Listing as Threatened
SE: State-listed as Endangered
ST: State-listed as Threatened
SR: State-Listed Rare
CNPS List 1B: Rare, threatened, or endangered in California and elsewhere.
CNPS List 2: Rare, threatened of endangered in California, but more common elsewhere.

Table 2
SPECIAL-STATUS WILDLIFE SPECIES
POTENTIALLY OCCURRING IN THE PROJECT AREA

Species	Status	Habitat Associations	
		General	Micro
Pale big-eared bat *Corynorhinus townsendii pallescens*	FSC, CSC BLM Sensitive FS Sensitive	Lives in a wide variety of habitats but most common in mesic sites.	Need appropriate roosting, maternity, and hibernacula sites free from human disturbance.
Mohave ground squirrel *Spermophilus mohavensis*	FSC, ST	Open desert scrub, alkali scrub & Joshua tree woodland. Also feeds in annual grasslands. Restricted to Mojave desert.	Prefers sandy to gravelly soils, avoids rocky areas. Uses burrows at base of shrubs for cover. Nests are in burrows.
Desert tortoise *Gopherus agassizii*	FT, ST	Most common in desert scrub, desert wash, and Joshua tree woodland. Occurs in almost every desert habitat.	Require friable soil for burrow and nest construction. Creosote bush habitat with large annual wildflower blooms preferred.
Owens valley vole *Microtus californicus vallicola*	CSC	Found in wetlands and lush grassy ground in the Owens Valley.	Needs friable soil for burrowing. Eats grasses, sedges & herbs. Clips grass to make runways leading from burrows.

Key:
FE: Federally Listed as Endangered
FT: Federally Listed as Threatened
FPE: Federally Proposed for Listing as Endangered
FPT: Federally Proposed for Listing as Threatened
FSC: Federal Species of Concern
FS Sensitive: Forest Service Sensitive
SE: State-Listed as Endangered
ST: State-Listed as Threatened
CDFG: FP: California Department of Fish and Game Fully Protected Species
CSC: California Special Concern Species
BLM Sensitive: Species (1) that are under status review by the FWS/NMFS: (2) whose numbers are declining so rapidly that Federal listing my become necessary; (3) with typically small and widely dispersed populations; or (4) that inhabit ecological refugia or other specialized or unique habitats.

1.3 Other Special-Status Species Summary

Six special-status plant species and two special-status animal species that are not listed as threatened or endangered potentially occur in the project area. The biology, distribution, and local occurrence of these species are described in detail in Section 3 of this report.

2 PROPOSED ACTION

2.1 Proposed Project

The purpose of the proposed Hay Ranch Water Extraction and Delivery System Project is to develop an injection system to maintain the Coso Geothermal Project's electric production by minimizing the geothermal reservoir decline through the replacement of lost geothermal fluids. In order to accomplish this, ground water will be extracted from two existing wells and piped to one injection well (Well 88-1RD) and the existing injection distribution system.

The two existing North and South Water Wells at the Coso Hay Ranch will be the source of the water. An underground pipeline will be installed from the Northern Well past the Southern Well to a 250,000

gallon capacity collection tank placed on sand bedding. The South Well will be tied into this pipeline. Water from the collection tank would be piped to the existing Coso Geothermal Project to the east.

The proposed pipeline is approximately 10-miles long and proceeds in a generally southeasterly direction from the collection tank along an existing access road, generally rising in altitude to Coso Junction Road. The proposed pipeline crosses Coso Junction Road and proceeds east adjacent to the road along the southern and western edges until just east of the China Lake Naval Weapons Center ("China Lake NWC" or "CLNWC") entry gate. The proposed pipeline would then cross Coso Junction Road just south of the CLNWC gate and proceed easterly for approximately 1 mile on the eastern edge of the road. The pipeline would then cross back over the road to a holding tank within CLNWC Testing Range. From the holding tank the pipeline would proceed southeasterly to the injection well. Preliminary pipe sizes for the project are 12-inch pipes from the water wells to the pump station, 20-inch pipes from the pump station to the high point tank and from the high point tank to the injection well field, and 8-inch injection well piping.

The project site encompasses an approximately 10 mile long corridor with a fifty-foot (50') right of way. The total project site is approximately 65 acres in size, 5 acres for the collecting and holding tanks and approximately 60 acres for the pipeline. Approximately 10 acres of the site is on the Coso Hay Ranch (private land) and approximately 36 acres is on land managed by the Bureau of Land Management (BLM), and approximately 19 acres is on the China Lake NWC.

An electric substation will be constructed adjacent to the North Water Well near the existing Southern California Edison electric transmission line. The substation will be approximately ¼-acre in size.

2.2 Project Location

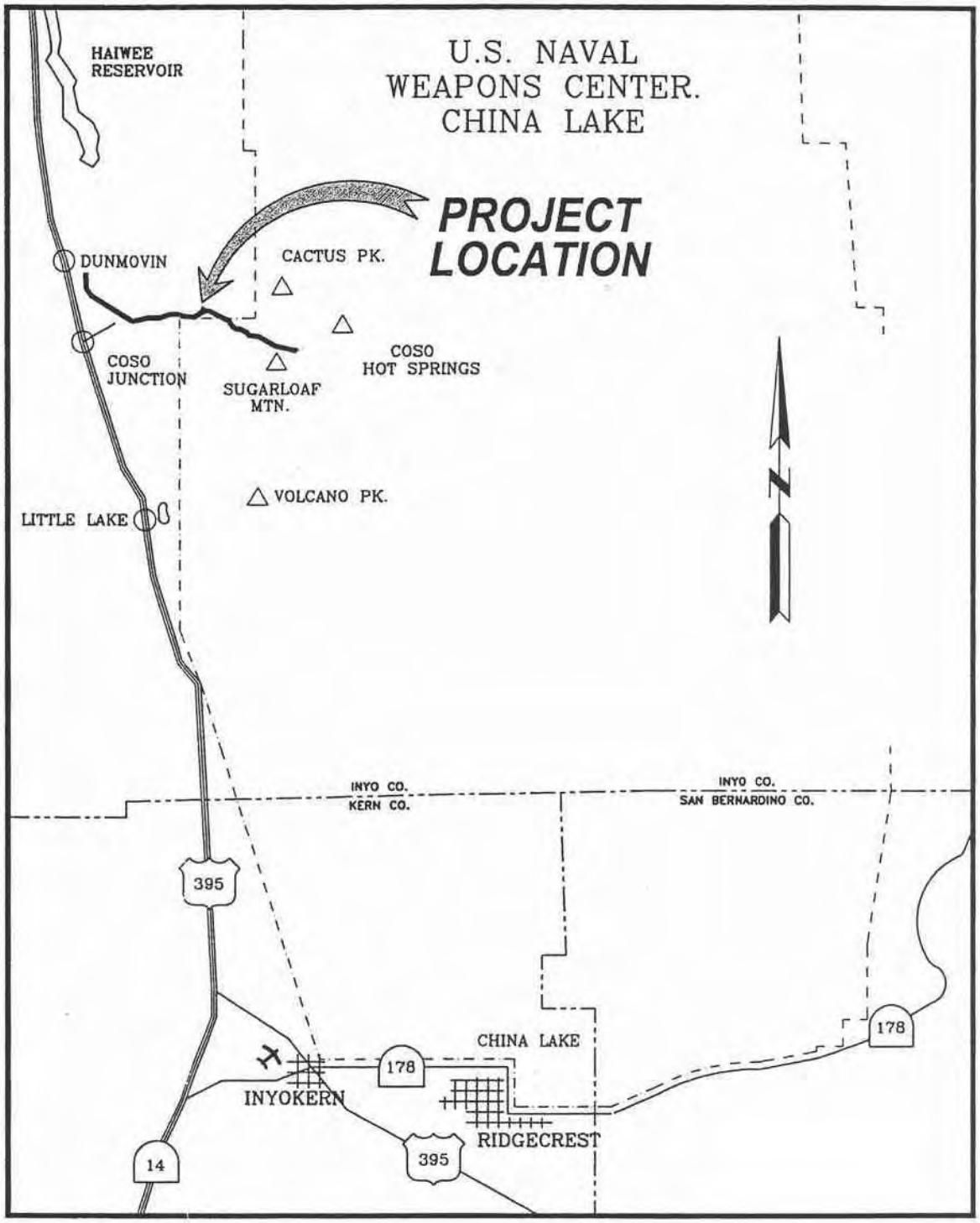
The proposed Hay Ranch Water Extraction and Delivery System Project (Project) is located approximately 35 miles northwest of Ridgecrest, California, in an unincorporated area of Inyo County (Figure 1, Regional Vicinity). The project is mapped on two United States Geological Survey (USGS) 7.5-minute Series Topographic quadrangles, Coso Junction and Cactus Peak (in Township 21 South, Range 37 East, Sections 25, 26, 35, and 36; Township 21 South, Range 38 East, Sections 31, 32, 33, and 34; and Township 22 South, Range 38 East, Sections 3, 2, and 1).[7]

The project site lies immediately east of Highway 395 (Figure 2, Project Area). Approximately 15% of the project is on private land in Rose Valley and the remainder is on public land. The project site encompasses an approximately 10-mile-long corridor extending from the Coso Hay Ranch to the Coso Geothermal Project (Figure 3, Project Site).

2.3 Project Area

The project area is generally flat to rolling topography with elevation varying from 3,200 to 4,300 feet. The western portion of the project area is on private agricultural land while the eastern portion is BLM and military reservation land. The project area is arid Mojave Desert with sparse vegetation. Highway 395 to the west of the project area is a major north south transportation corridor on the east side of the Sierra Nevada Mountains.

[7] Coso Junction and Cactus Peak Topographic Quadrangle Maps. Source: All Topo Maps. Contact: IGAGE Mapping Corporation, P.O. Box 58596, Salt Lake City, UT 84158-9912.



(Not to scale)

Figure 1
REGIONAL VICINITY

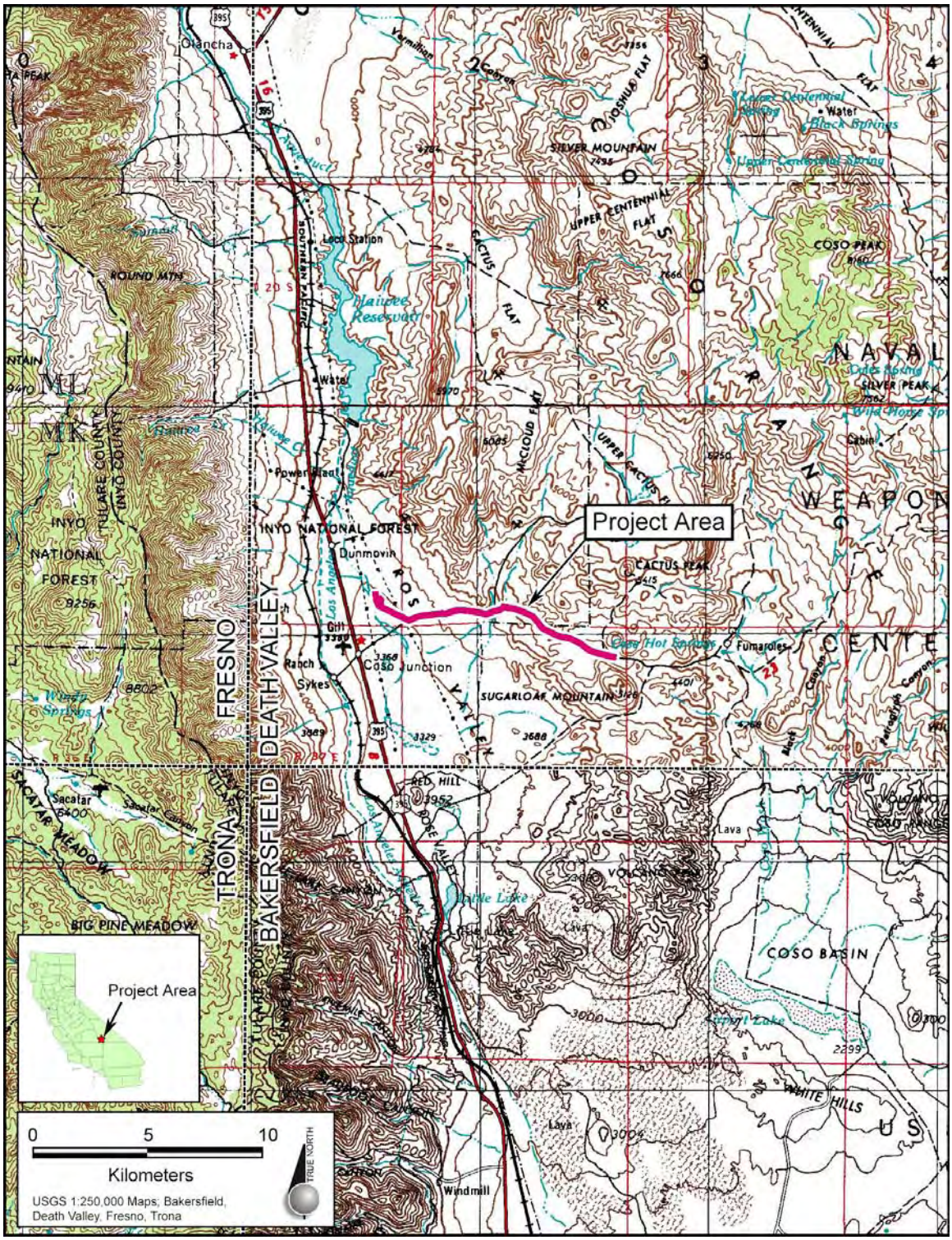


Figure 2
PROJECT AREA

INSERT FIGURE 3 (PROJECT SITE)

2.4 Project Implementation

The project would be implemented with standard techniques including surveying, grading, trenching, and tank construction. Typical equipment such as bulldozers, backhoes, tractor-trailer trucks, welding and fabricating equipment would be used.

2.5 General Habitat Description

The proposed project lies in the western portion of the Mojave Desert, a subdivision of the Mojave Desert Biome that has a distinct flora and fauna.[8] The West Mojave Desert is generally flat and sparsely vegetated with creosote bush and saltbush plant communities dominating the landscape.[9] Most of the west Mojave lies between 2500 and 4000 feet and is considered high desert. Summer temperatures are often above 100°F, in winter snow and frost can occur with temperatures sometimes below 32°F. Annual precipitation is low and quite variable.

Three plant communities, (as defined by CNDDB and/or Sawyer Keeler-Wolf [10, 11]) occur in the project site: creosote-white bursage scrub, allscale scrub and agricultural land. Their occurrence on the project site is described in detail in Section 3 of this report.

2.5.1 Creosote-White Bursage Scrub

Creosote-white bursage scrub is a series within Mojave creosote bush scrub, which is often considered as a collection of series. In creosote-white bursage scrub, creosote bush and white bursage are equally important, and brittlebush can be a third common species. Mojave creosote bush scrub is the most extensive cover type in the Mojave Desert region, covering 57% of the land surface.[12] Perennial shrubs are generally widely spaced in creosote bush scrub, usually with bare ground between. Plant growth occurs during spring and is prevented by winter cold and seasonal drought. Many species of ephemeral herbs may flower in late March and April if the winter rains are sufficient. Other, less numerous species of annuals appear following summer thundershowers.

2.5.2 Allscale Scrub

Allscale scrub is often considered part of the saltbush scrub collection of series with allscale (*Atriplex polycarpa*) as a dominant species. Saltbush scrub is an assemblage of low, grayish shrubs, one to four feet tall, with some succulent species. Allscale series occurs with different associates regionally as suggested by CNDDB categories. Total ground cover is often low, with bare ground between perennial plants.

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[8] Bureau of Land Management (BLM), 2003. Draft Environmental Impact Report and Statement for the West Mojave Plan, A Habitat Conservation Plan and California Desert Conservation Area Plan Amendment. Vols. I and II. U.S. Dept Interior.

[9] Bureau of Land Management (BLM), 2003. Draft Environmental Impact Report and Statement for the West Mojave Plan, A Habitat Conservation Plan and California Desert Conservation Area Plan Amendment. Vols. I and II. U.S. Dept Interior.

[10] CNDDB September 2003. List of California Terrestrial Natural Communities Recognized by The California Natural Diversity Database. CDFG Habitat Data Analysis Branch, Vegetation Classification and Mapping Program.

[11] Sawyer Keeler-Wolf.

[12] Bureau of Land Management (BLM), 2003. Draft Environmental Impact Report and Statement for the West Mojave Plan, A Habitat Conservation Plan and California Desert Conservation Area Plan Amendment. Vols. I and II. U.S. Dept Interior.

2.5.3 Agricultural Land

The western portion of the project site is agricultural land that is currently fallow. The agricultural land had previously been used to grow alfalfa and possibly other crops.

There are no watercourses, wetlands, springs, or seeps on the project site.

2.6 Current Land Management

Land management in the project area consists of private land managed for agriculture, public land administered by BLM, public land administered by BLM that is under protective withdrawal, and public land withdrawn as military reservation. The military reservation lands are used for training, testing and geothermal power production. The military lands are managed by the Department of Defense (DOD).

3 AFFECTED ENVIRONMENT

3.1 Methods

3.1.1 Literature Review

UltraSystems reviewed available literature to identify any special status plants, wildlife, or sensitive communities known from the vicinity of the project site. The review included the California Native Plant Society's (CNPS) Electronic Inventory of Rare and Endangered Vascular Plants of California,[13] Calflora Database,[14] compendia of special-status species published by CDFG,[15,16] and the California Department of Fish and Game's (CDFG) California Natural Diversity Database (CNDDB)[17] for the Coso Junction and Cactus Peak 7.5-minute series topographic quadrangles, and surrounding quadrangles (Haiwee Pass, Haiwee Reservoirs, Upper Centennial Flat, Coso Peak, Long Canyon, Petroglyph Canyon, Sacatar Canyon, Little Lake, Volcano Peak, and Airport Lake).

Special-status species include:

- Species listed as Threatened or Endangered under the Federal Endangered Species Act (ESA),
- Species proposed for listing as Threatened or Endangered under the ESA,
- Species listed by the State of California as Threatened, Endangered or Rare under the California Endangered Species Act (CESA),

[13]/ California Native Plant Society. 2001. Electronic Inventory of Rare and Endangered Vascular Plants of California (electronic records of sensitive species on the USGS 7.5' Condor Peak Quadrangle). California Native Plant Society, Sacramento.

[14]/ CalFlora: Information on California plants for education, research and conservation. [web application]. 2000. Berkeley, California: The CalFlora Database [a non-profit organization]. Available: http://www.calflora.org.

[15]/ California Department of Fish and Game (CDFG), Natural Diversity Data Base. 2003b. Special Plants. Unpublished report available from CDFG, Natural Heritage Division, Sacramento. January.

[16]/ California Department of Fish and Game, Natural Diversity Data Base. 2003c. Special Animals. Unpublished report available from CDFG, Natural Heritage Division, Sacramento. January.

[17]/ California Department of Fish and Game (CDFG), February 5, 2004. *Rarefind 2: A Database Application for the Use of the California Department of Fish and Game Natural Diversity Base*. Sacramento, CA: California Department of Fish and Game.

- Species proposed for listing as Threatened or Endangered under the CESA,
- Fully protected animals in California (CDFG Code, Sections 3511 [birds], 4700 [mammals], and 5050 [reptiles and amphibians]),
- CNPS List 1A, plants presumed extinct in California,
- CNPS List 1B, Rare or Endangered plants in California and elsewhere,
- CNPS List 2, Rare or Endangered plants in California, more common elsewhere,
- CNPS List 3, plants for which we need more information – review list,
- CNPS List 4, plants of limited distribution watch list,
- Forest Service Sensitive species, and
- BLM Sensitive Species.

3.1.2 Field Surveys

The entire project site was surveyed by vehicle and on foot on May 11, 12, and 13, 2004, by Dr. Robert Motschall, UltraSystems Senior Biologist; Jeff Kidd, Permitted Desert Tortoise Biologist; and Timothy Waldie, UltraSystems Biologist and CDFG Rare Plant Collection Permittee. The proposed substation site and connecting line route was surveyed by vehicle and on foot on February 23, 2005 by Gregg Miller, UltraSystems Senior Biologist, and Melissa Clemons, UltraSystems Biologist. The survey objectives were:

- (1) Review vegetation communities on and in the vicinity of the site,
- (2) General plant and wildlife survey, and
- (3) Special status plant and wildlife species survey.

During the surveys, particular focus was placed on locating sensitive biological resources including special-status species and their habitats. Potential impacts on biological resources were recorded. During the field surveys, plant and wildlife species were recorded.

A 50-foot wide corridor along the proposed pipeline alignment (approx. 10 miles) was surveyed for special-status species with a focus on desert tortoise, Mohave ground squirrel and sign of these species. Surveys were conducted on foot by two (2) qualified biologists by meandering and intersecting transects. An additional 50-feet (25' on each perimeter) were surveyed by random meandering transect by one (1) qualified biologist. All potential desert tortoise burrows within the survey area were located with a hand-held GPS unit and checked for tortoise activity using a fiber-optic scope. Data on burrow size and conditions were recorded, and each potential burrow was identified with a unique waypoint number using GPS. The pipeline alignment survey corridor was searched for sign of desert tortoise including scat, palettes, and old carapaces (shells). Wildlife and sign were identified and catalogued.

The approximately 20-acre area surrounding the approximately ¼ acre electric substation site and connection transmission line right-of-way was surveyed for habitat type and potential for special status species occurrence.

3.2 Results

3.2.1 Plant Communities

As noted previously there are three plant communities on the project site: creosote-white bursage scrub, allscale scrub and agricultural land. Plant species observed on the site are shown in Table 3.

Table 3
PLANT SPECIES OBSERVED ON THE PROJECT SITE

Scientific Name	Common Name
Acacia greggii	Catclaw Acacia
Ambrosia dumosa	White Bursage
Amsinckia tessellata	Bristly Fiddleneck
Artemisia spinescens	Bud Sage, Budsage
Atriplex canescens	Shadscale
Atriplex confertifolia	Spiny Saltbush
Atriplex parryi	Parry's Saltbush
Atriplex polycarpa	Allscale
Atriplex spinifera	Spinescale
Chrysothamnus teretifolius	Green Rabbit Brush
Echinocactus polycephalus var. polycephalus	Clustered Barrel Cactus
Ephedra californica	Ephedra
Erigeron compositus	Cut Leaf Daisy
Eriogonum brachyanthum	Short-Flowered Buckwheat
Eriogonum inflatum	Desert Trumpet
Eriogonum mohavense	Western Mojave Buckwheat
Eriogonum nidularium	Birdnest Buckwheat
Erodium botrys	Storksbill
Hymenoclea salsola	Cheesebush
Isomeris arborea	Bladderpod
Langoisia schottii	Schott’s Calico
Larrea tridentata	Creosote
Nama demissum	Purple Mat
Opuntia basilaris	Beavertail
Opuntia bigelovii	Teddy Bear Cholla
Oryzopsis hymenoides	Indian Ricegrass
Phacelia bicolor var. bicolor	Trumpet Phacelia
Phacelia inyoensis	Inyo Phacelia
Physalis crassifolia	Thick-Leaved Ground Cherry
Ranunculus glaberrimus	Sagebrush Buttercup
Salvia carduacea	Sage Thistle
Salvia columbariae	Chia
Sphaeralcea ambigua	Desert Mallow
Suaeda calceoliformis	Pursh’s Seepweed
Yucca brevifolia	Joshua Tree

Creosote-white bursage scrub on the project site contains widely spaced creosote bushes (*Larrea tridentata*) with white bursage shrubs (*Ambrosia dumosa*) as co-dominants. Creosote-white bursage scrub also contains teddy-bear cholla (*Opuntia bigelovii*), beavertail cactus (*Opuntia basilaris*) and

scattered Joshua trees (*Yucca brevifolia*). Creosote-white bursage scrub north of Coso Junction Road has been heavily grazed.

Allscale scrub on the project site is generally undisturbed with a developed understory. It contains bristly fiddleneck (*Amsinckia tessellata*), shadscale (*Atriplex canescens*), green rabbit brush (*Chrysothamnus teretifolius*), ephedra (*Ephedra californica*), desert trumpet (*Eriogonum inflatum*), cheesebush (*Hymenoclea salsola*) and numerous other plant species as shown in Table 1. The Allscale scrub north of Coso Junction Road has been heavily grazed.

Agricultural land on the project site is currently fallow. Alfalfa and possibly other crops were previously grown on the site using groundwater for irrigation.

3.2.2 Wildlife

The plant communities form the basis of the wildlife habitats of the project area. They provide the primary plant productivity upon which wildlife depends, along with nesting and denning sites, escape cover and protection from adverse weather. Many of the wildlife species that occur in the area use several of the plant communities to obtain all their life history needs.

In general, more complex plant communities, with more vegetation layers and more plant species, provide higher value wildlife habitat than less complex vegetation communities. More complex plant communities have more niches for wildlife and usually support more animal species than less complex communities.

Wildlife species observed on the project site are shown in Table 4.

The creosote bush scrub and Allscale plant communities in the proposed project area are expected to support many common desert species, including desert iguana (*Dipsosaurus dorsalis*), desert spiny lizard (*Sceloporus magister*), western brush lizard (*Urosaurus graciosus*), side-blotched lizard (*Uta stansburiana*), coachwhip (*Masticophis flagellum*), western patch-nosed snake (*Salvadora hexalepis*), California kingsnake (*Lampropeltis getula*), western shovel-nosed snake (*Chionactis occipitalis*), sidewinder (*Crotalus cerastes*), cactus mouse (*Peromyscus eremicus*), deer mouse (*Peromyscus maniculatus*), southern grasshopper mouse (*Onychomys torridus*), black-tailed jackrabbit (*Lepus californicus*), and desert cottontail (*Sylvilagus auduboni*). The proposed project area may provide foraging habitat for various bat species, including the California leaf-nosed bat (*Macrotus californicus*), spotted bat (*Euderma maculata*), Townsend's big-eared bat (*Corynorhinus townsendi*), Brazilian free-tailed bat (*Tadarida brasiliensis*), and the western mastiff bat (*Eumops perotis*). Additionally, the proposed project area provides foraging habitat for ravens (*Corvus corax*), loggerhead shrikes (*Lanius ludovicianus*), and various raptor species, including the red-tailed hawk (*Buteo jamaicensis*) and the prairie falcon (*Falco mexicanus*). [18,19,20]

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[18]/ California Department of Fish and Game. California Interagency Wildlife Task Group. 2002. CWHR Version 8.0 Personal Computer Program: Sacramento, CA.

[19]/ Robert C. Stebbins, 1995. A Field Guide to Western Reptiles and Amphibians. Houghton Mifflin Company: Boston, MA.

[20]/ William H. Burt and Richard P. Grossenheider. 1976. A Field Guide to the Mammals of North America north of Mexico. Houghton Mifflin Company: Boston, MA.

Table 4
WILDLIFE SPECIES OBSERVED OR DETECTED BY SIGN ON THE PROJECT SITE

Scientific Name	Common Name
Reptiles	
Callisaurus draconoides	Zebra Tail Lizard
Chionactis occipitalis	Western Shovel-Nosed Snake
Cnemidophorus tigris	Desert Whiptail
Dipsosaurus dorsalis	Desert Iguana
Gopherus agassizii	Desert Tortoise
Phrynosoma platyrhinos ssp. calidiarum	Desert Horned Lizard
Birds	
Buteo jamaicensis	Red-Tailed Hawk
Corvus corax	Raven
Eremophila alpestris	Horned Lark
Regulus calendula	Ruby-Crowned Kinglet
Salpinctes obsoletus	Rock Wren
Spizella atrogularis	Black-Chinned Sparrow
Wilsonia pusilla	Wilson's Warbler
Mammals	
Ammospermophilus leucurus	White-Tailed Antelope Ground Squirrel
Lepus californicus	Black-Tailed Jackrabbit
Neotoma lepida	Desert Woodrat
Vulpes macrotis	Kit Fox
Butterflies	
Brephidium exilis	Pygmy Blue
Pieris rapae	Cabbage White

3.2.3 Special-Status Species Background

The U.S. Fish and Wildlife Service (USFWS) administers the federal Endangered Species Act (ESA). The ESA provides a process for listing species as either threatened or endangered, and methods of protecting listed species. The ESA defines as “endangered” any plant or animal species that is in danger of extinction throughout all or a significant portion of its range. A “threatened” species is a species that is likely to become endangered in the foreseeable future. A “proposed” species is one that has been officially proposed by USFWS for addition to the federal threatened and endangered species list.

Section 9 of the ESA prohibits “take” of threatened or endangered species. The term “take” means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in such conduct. Take can include disturbance to habitats used by a threatened or endangered species during any portion of its life history. Under the regulations of the ESA, the USFWS may authorize “take” when it is incidental to, but not the purpose of, an otherwise lawful act.

The California Department of Fish and Game administers the state Endangered Species Act. The State of California considers an endangered species one whose prospects of survival and reproduction are in immediate jeopardy, a threatened species is one present in such small numbers throughout its range that it is likely to become an endangered species in the near future in the absence of special protection or management, and a rare species is one present in such small numbers throughout its range that it may become endangered if its present environment worsens. Rare species applies to California native plants.

State threatened and endangered species are fully protected against take, as defined above. Species of Special Concern is an informal designation used by CDFG for some declining wildlife species that are not state candidates. This designation does not provide legal protection, but signifies that these species are recognized as sensitive by CDFG.

The California Native Plant Society (CNPS) has developed an inventory of California's sensitive plant species (Skinner and Pavlik 1994). This inventory summarizes information on the distribution, rarity, and endangerment of California's vascular plants. The inventory is divided into four lists based on the rarity of the species. In addition, the CNPS provides an inventory of plant communities that are considered sensitive by the state and federal resource agencies, academic institutions, and various conservation groups. Determination of the level of sensitivity is based on the number and size of remaining occurrences as well as recognized threats.

Sensitive habitats are natural communities that support concentrations of sensitive plant or wildlife species, are of relatively limited distribution, or are of particular value to wildlife. Sensitive habitats are not afforded legal protection unless they support protected species, except for wetland habitats which cannot be filled without authorization from the U.S. Army Corps of Engineers (USACE) and CDFG.

3.2.4 Threatened and Endangered Species

Mohave Ground Squirrel

The Mohave ground squirrel is a small diurnal ground squirrel found in the western Mojave Desert. The ground squirrel ranges from Palmdale in the south, to Olancha in the north, and from the town of Mojave eastward to Fort Irwin.[21] The Mohave ground squirrel occupies all major desert scrub habitats in the western Mojave Desert. It has been observed in Creosote Scrub, Desert Saltbush Scrub, Desert Sink Scrub, Desert Greasewood Scrub, Shadscale Scrub, and Joshua tree woodland.[22]

They spend the majority of the year in estivation to avoid temperature extremes and food scarcity. They are active above ground from early February for brief periods. Above ground activity increases in mid-March with the breeding season. Ground squirrels begin entering estivation by July with most above ground activity ending by August.[23]

Mohave ground squirrels were not observed during the field surveys. Burrows of appropriate size for Mohave ground squirrel were found during the surveys.

The Mohave ground squirrel is known to occur on the China Lake Naval Weapons Center and is expected to occur on the project site in creosote white bursage scrub and desert saltbush scrub habitats.

[21] Bureau of Land Management (BLM), 2003. Draft Environmental Impact Report and Statement for the West Mojave Plan, A Habitat Conservation Plan and California Desert Conservation Area Plan Amendment. Vols. I and II. U.S. Dept Interior.
[22] BLM 2003
[23] BLM 2003

Desert Tortoise

The desert tortoise is an herbivorous reptile occurring in deserts of the southwest. The desert tortoise occurs throughout the Mojave and Colorado deserts in California Nevada, Utah, and Arizona. The preferred habitats of the tortoise are desert scrub, desert wash, and Joshua tree, but the tortoise is found in other desert habitats. Tortoises consume annual grasses and forbs and prefer green plants over dry plants.[24] Desert tortoises are mostly found in flats, valleys, bajadas, and rolling hills between 2,000 and 3,300 feet.[25]

Tortoises excavate and use burrows for protection from both high and low temperatures in the desert. Burrows are also used for winter hibernation. Friable soil is required for burrow and nest excavation. Tortoises mate in late March and early April, with eggs being laid in early summer. Eggs hatch in early fall generally coinciding with the growth of grasses and forbs from fall rains.[26]

Desert tortoise are known to occur on the China Lake Naval Weapons Center and in Rose Valley, although in lower densities than in more southerly portions of the tortoise's range.[27]

Desert tortoises were not observed during the field survey. Burrows of appropriate size ranging in 5" to 12" diameter consistent with that known for desert tortoise were flagged and examined along the proposed pipeline route approximately 50 m from the existing road. The flagged potential burrows were determined to be unoccupied and were of poor quality, evidenced by partial collapse or obvious disuse.

Although the chances seem small of encountering a desert tortoise within the construction area, preauthorizing a biologist qualified to move a tortoise is advised. The U.S. Fish and Wildlife Service field office must be notified in advance if a desert tortoise is to be moved.

3.2.5 Other Special-Status Species

Charlotte's Phacelia

Charlotte's phacelia is primarily found on the east slope of the southern Sierra Nevada Mountains to the El Paso Mountains. It is found west of the Sierra crest in the Lake Isabella watershed; locally, it is found in areas of Inyo County and on China Lake NWC.

Charlotte's phacelia occurs in pinyon-pine woodlands on steep, coarse sand and talus. It is generally found on granitic substrates, but occasionally on dark volcanic material and metamorphic rock. Charlotte's phacelia grows on naturally disturbed sites, including washes. It occurs at elevations of 2000 to 7200 feet. At lower elevations, Charlotte's phacelia is found in Mojave Desert scrub with creosote bush, beavertail cactus, and burrobush.

Charlotte's phacelia may occur on the project site.

[24] Zeiner et al. 1990.
[25] BLM 2003.
[26] Zeiner et al. 1990.
[27] BLM 2003.

Darwin Mesa Milk-Vetch

Darwin mesa milk-vetch is found in Desert Mountains (north and west of Panamint Valley, Inyo Co.). It occurs at elevations of 4288 – 7408 feet. It is found in a variety of habitats including pinyon pine, pinyon-juniper woodland, sagebrush scrub, and Joshua tree woodland and is usually found on volcanic clay or gravelly substrates.

Darwin mesa milk-vetch is not expected to occur on the project site.

Sanicle Cymopterus

Sanicle cymopterus is a small perennial herb from a buried root crown. It grows in loose sandy to gravelly, often somewhat alkaline soils on volcanic tuff deposits and mixed valley alluvium, typically inhabits small drainage-ways, in the blackbrush, mixed-shrub, sagebrush, and lower pinyon-juniper zones. It has been observed at elevations of 3,150 to 6,720 feet.

Sanicle Cymopterus may occur on the project site.

Inyo Hulsea

Inyo hulsea is known from the Inyo, Coso, and Panamint Mountains, in Inyo County. Known locations of Inyo hulsea are sparse because due to inaccessibility and administrative prohibitions against entry collection on military lands. The Coso Mountains location is based on an 1893 collection and the plant is likely to occur in the mountains within the China Lake NWC.

Inyo hulsea occurs between 4,600 and 7,300 feet in elevation. It is found on steep, unstable, sandy or rocky slopes and sometimes in washes in high desert shrublands and pinyon woodlands. Associated species include big sagebrush, saltbush, rabbitbrush, single-needle pinion, and antelope brush.

This species has potential to occur within the project boundaries at the higher elevations.

Pinyon Rock Cress

Pinyon rock cress can be found in Joshua tree woodland, pinyon-juniper woodland, Mojave Desert scrub, and creosote brush scrub. It occurs in Inyo, Mono, San Bernardino, and Tulare counties. It is found at elevations of 3,940 to 7,870 feet in habitats that have granitic, gravelly slopes and mesas. Pinyon rock cress is often found under desert shrubs, which support it as it grows.

Pinyon rock cress has the potential to occur on the project site in the higher elevations of creosote–white bursage scrub.

Creamy Blazing Star

Creamy blazing star is found in central Mojave Desert scrub, specifically creosote-bush scrub at elevations of 2,300 to 3,800 feet.

Creamy blazing star has the potential to occur on the project site.

Townsend's Big-Eared Bat

The Townsend's big-eared bat occurs throughout California from the humid forests in the northwest portion of the state to the drier portions of the state from the Central Valley through the Sierra Nevada Mountains to the deserts of the southeast part of the state.[28] The pale big-eared bat is a cave dwelling bat that is found in a variety of habitats; typically open habitats such as shrubland, shrub-steppe or desert scrub. Big-eared bats require caves, mines, tunnels, buildings or other man-made structures for roosting. They may use separate sites for night, day, hibernation, or maternity roosts. Maternity sites are in relatively warm, well-ventilated sites and births occur in May and June. The Townsend's big-eared bat exhibits a high degree of site fidelity, returning year after year to the same maternity roosts. Big-eared bats hibernate from October to April.[29] There are 12 known big-eared bat roost sites east of the Sierra Nevada Mountains (Mono, Inyo, northeast Kern, and northwestern San Bernardino Counties). Eleven of the 12 are located in mines, largely on public lands.[30]

The pale big-eared bat may forage over the site. However, because of the absence of suitable roost sites, the pale big-eared bat is not expected to roost on the project site.

Owens Valley Vole

The Owens Valley vole, a subspecies of the California vole, is found in the Owens Valley and areas to the south.[31] Voles breed throughout the year, and reach population peaks if food and cover are abundant. Voles forage on the ground feeding on leafy parts of grasses, sedges, and herbs. They clip grasses and forbs at the base, which forms a network of runways around their burrows. The Owens Valley vole is found in wetlands and dense grass habitats in the Owens Valley.[32] The CNDDB contains twelve occurrences of the Owens Valley vole, largely from historic records, ranging from the Bishop area in the north to Little Lake in the south.

Although the site is within the historic range of the Owens Valley vole, the vole is not expected to occur on site due to the absence of suitable habitat.

3.3 Land Management

The western portion (approximately 10 acres) of the project site is private land that has been managed for agriculture, but is currently fallow.

The eastern portion (approximately 55 acres) of the project site is federal land that is administered by BLM. The BLM administered land includes land under protective withdrawal and land withdrawn as military reservation. The military reservation land (approximately 19 acres) is managed by the Department of Defense (DOD) and is used for military training, weapons testing, and geothermal power production.

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[28] California Department of Fish and Game, 1986. Mammalian Species of Special Concern in California.
[29] CDFG 1986
[30] Pierson, E.D. and W.E. Rainey, 1994. Distribution, Status, and Management of Townsend's Big-Eared Bat *(Corynorhinus townsendi)* in California. California Department of Fish and Game, Bird and Mammal Conservation Program. BMCP Tech. Rep. 96-7.

[31] CNDDB 2004
[32] CNDDB 2004

4 ENVIRONMENTAL CONSEQUENCES

4.1 Effects on Plants Communities

Approximately 5 acres of plant communities would be permanently affected, and approximately 60 acres of plant communities will be temporarily affected by the proposed pipeline project.

No special status plants would be affected by the proposed project.

4.2 Effects on Wildlife

Approximately 5 acres of wildlife habitat will be permanently affected, and approximately 60 acres of wildlife habitat will be temporarily affected by the proposed pipeline project.

4.3 Effects on Threatened and Endangered Species

No threatened or endangered plant species would be affected by the proposed project.

Mohave ground squirrel and desert tortoise could be directly affected during construction of the pipeline. Individual Mohave ground squirrel or desert tortoise could potentially be killed or injured in burrows or above ground during construction. Implementing the proposed mitigation is expected to avoid directly affecting Mohave ground squirrel or desert tortoise.

The proposed project is expected to permanently impact approximately 5 acres and temporarily affect approximately 60 acres of potential habitat for Mohave ground squirrel and desert tortoise.

4.4 Effects on Other Special-Status Species

No special status plant species that are not listed as threatened or endangered would be affected by the proposed project.

5 PROPOSED MITIGATION

Mitigation for permanent impacts on 5 acres and temporary impacts on 60 acres of Mohave ground squirrel and desert tortoise habitat is covered under the existing Mohave Ground Squirrel Mitigation Plan for development of the Coso Known Geothermal Area. The Mitigation Plan allows for construction or disturbance of up to 2,100 acres. The impacts are within the allowed acreage for the Mitigation Plan.

The pipeline was redesigned to avoid the potentially viable desert tortoise burrow (Waypoint #34).

The following mitigation measures are proposed:

- The potentially viable desert tortoise burrow (Waypoint #34) will be flagged for protection during construction.
- A tortoise-proof exclusion fence will be constructed around the proposed project construction area including laydown and stockpile sites in potential tortoise habitat. Immediately prior to

construction, clearance surveys will be conducted for the desert tortoise and all desert tortoises within the exclusion fence will be relocated outside the fence.

- Desert tortoise surveys, handling and relocation will be conducted by a trained biologist approved by resource agencies for handling and relocation of desert tortoise. Only tortoises in the construction area or otherwise in harm's way will be relocated.
- Because adult tortoises are most likely to be active above ground from February 15 to November 15 and least likely from November 16 to February 14, preconstruction surveys will be conducted within 48 hours before construction from February 15 to November 15 and will be done within two weeks prior to construction between November 16 and February 14.
- All potential tortoise burrows in the construction zone, including those not recently used, shall be excavated by an approved biologist at the time of the survey.
- An environmental monitor will be present and will monitor all construction activities.
- If a recently dead or injured desert tortoise is found the approved biologist shall immediately notify the USFWS and CDFG.
- Construction personnel will look for desert tortoises under vehicles and equipment before they are moved. If a desert tortoise is present, the vehicle will not be moved until the tortoise has moved from under the vehicle and out of harm's way, or the approved biologist has relocated the tortoise.
- Trash and food items shall be contained in closed containers and regularly removed to reduce the attractiveness of the area to opportunistic predators such as common ravens, coyotes and feral dogs.
- Pets will be prohibited from the construction site.
- The top 8 inches of removed soil will be salvaged and stockpiled on site. Following construction the salvaged topsoil will be used as final cover over the pipeline.
- Following construction, the pipeline corridor will be restored based on the existing approved restoration plan.
- All construction workers will participate in a Mohave ground squirrel and desert tortoise education program prior to construction. The program will include identification, basic biology, general behavior, local distribution, sensitivity to human activities, legal protection, penalties for violating State or federal laws, impact avoidance methods, and reporting requirements. Construction personnel will be instructed not to handle desert tortoise.
- Driving off established roads will be prohibited unless required by construction activities.
- Vehicle speeds shall not exceed 25 miles per hour through desert tortoise habitat unless otherwise posted.
- Prior to construction the pipeline route will be surveyed for nesting horned larks and other ground nesting birds. If nests are located a 50 feet buffer around the nest will be flagged. No construction will occur within the buffer until monitoring indicates that the young have fledged and the nest is no longer active.

6 RESIDUAL EFFECTS

No residual effects are expected to special-status species or their habitats following implementation of the proposed mitigation measures.

7 CUMULATIVE EFFECTS

No cumulative effects are expected to special-status species or their habitats following implementation of the proposed mitigation measures.

8 CONCLUSIONS

Implementation of the proposed project and the mitigation measures is not expected to affect species that are listed as threatened or endangered by the federal or state governments.