SECTION 3

Affected Environment and Environmental Consequences

3.1 Scoping and Issue Identification

Internal and external (public) scoping was completed to identify any agency and/or public concerns, respectively, associated with the Proposed Action. Internal scoping was conducted by BLM resource specialists on August 2, 2010. Public scoping was conducted in coordination with the Churchill County Commission meeting on August 18, 2010. A 30-day public scoping period began on August 5, with notification to local newspapers of the intent to develop geothermal resources in Dixie Valley. Representatives from Nevada Division of Wildlife (NDOW), Churchill County, and Naval Air Station-Fallon (NAS Fallon) met with BLM staff and TGP on August 18, 2010, to discuss issues and concerns regarding the Proposed Action. These agencies, along with the U.S. Fish and Wildlife Service (USFWS), are coordinating partners concerning the Proposed Action. The following predominant issues were identified during internal and public scoping: possible exchange between deep reservoir fluid and shallow aquifer and preparation of a water monitoring program by TGP to assess water-related impacts. Written scoping comments were received during the 30-day scoping period. The only comment pertinent to this Proposed Action was from the public in favor of geothermal development in Dixie Valley.

3.1.1 Proposed Action General Setting

The Proposed Action area is approximately 55 miles northeast of Fallon, at elevations ranging from approximately 3,400 to 3,600 feet in the northern part of Dixie Valley. The Proposed Action area is on the eastern slope of the Stillwater Range in an area dominated by mixed salt desert scrub vegetation. Terrains within the Proposed Action area are gently sloping alluvial fans and valley bottom. Site drainage is mostly by sheet flow toward small southwest-to-northeast-trending ephemeral drainages, which may contain water during periods of heavy precipitation.

3.1.2 Supplemental Authorities

Appendix 1 of BLM's NEPA Handbook (H-1790-1) identifies Supplemental Authorities that are subject to requirements specified by statute or executive order and must be considered in all BLM environmental documents. Supplemental Authorities that may be affected by the Proposed Action are further described in this EA.

TABLE 3-1
Supplemental Authorities and Rationale for Detailed Analysis for the Proposed Action

Elements[a]	Not Present[b]	Present/ Not Affected	Present/ May Be Affected[c]	Rationale
Air Quality			X	Carried forward in Section 3.2.
Areas of Critical Environmental Concern	X			
Cultural Resources			X	Carried forward in Section 3.3.
Environmental Justice	X			
Farm Lands (prime or unique)	X			
Forests and rangelands (Healthy Forests Restoration Area projects only)				Not applicable
Human Health and Safety (herbicide projects)				Not applicable
Floodplains	x			
Invasive, Nonnative, and Noxious Species			X	Carried forward in Section 3.4.
Migratory Birds			X	Carried forward in Section 3.5.
Native American Religious Concerns			X	Carried forward in Section 3.8.
Threatened and/or Endangered Species	X			After consulting with the BLM wildlife biologist and the USFWS website for Nevada, there are no federally listed threatened or endangered species within the project area (USFWS, 2010). See Appendix B.
Wastes, Hazardous or Solid			X	Carried forward in Section 3.9.
Water Quality (Surface/Ground)			X	Carried forward in Section 3.11.
Wetlands/Riparian Zones	X			
Wild and Scenic Rivers	X			
Wilderness	X			

[a] See BLM Handbook H-1790-1(2008a) Appendix 1 *Supplemental Authorities to be Considered*.
[b] Supplemental Authorities determined to be Not Present or Present/Not Affected need not be carried forward or discussed further in the document.
[c] Supplemental Authorities determined to be Present/May Be Affected must be carried forward in the document.

3.1.3 Resources Other Than Supplemental Authorities

Resources or uses that are not Supplemental Authorities as defined by BLM's Handbook H-1790-1 (BLM, 2008a), are present in the Proposed Action area. BLM specialists have evaluated the potential impact of the Proposed Action on these resources and documented

their findings in Table 3-2. Resources or uses that may be affected by the Proposed Action are further described in this EA.

TABLE 3-2
Resources Other Than Supplemental Authorities

Resource or Issue	Present/ Not Affected[a]	Present/May Be Affected[b]	Rationale
Visual Resource Management		X	Carried forward in Section 3.12.
Recreation		X	Carried forward in Section 3.13.
Military Lands		X	Carried forward in Section 3.14.
Livestock Grazing		X	Carried forward in Section 3.15.
Lands		X	Carried forward in Section 3.16.
Geology/Minerals		X	Carried forward in Section 3.10.
Noise	X		
Soil		X	Carried forward in Section 3.17.
Vegetation		X	Carried forward in Section 3.18.
Wildlife		X	Carried forward in Section 3.6.
Special-status Species BLM Sensitive		X	Carried forward in Section 3.7.
Paleontological Resources		X	Carried forward in Section 3.19.

[a] Resources or uses determined to be Present/Not Affected need not be carried forward or discussed further in the document.
[b] Resources or uses determined to be Present/May Be Affected must be carried forward in the document.

3.1.4 Resources or Uses Present and Brought Forward for Analysis (All Supplemental and Resources)

The following resources are present in the Proposed Action area, may be affected by the Proposed Action, and are carried forward for analysis:

- Air Quality
- Cultural Resources
- Invasive, Nonnative and Noxious Species
- Migratory Birds
- Wildlife
- Special-status Species/BLM Sensitive
- Native American Religious Concerns
- Wastes, Hazardous or Solid
- Geology/Minerals
- Water Quality (surface/ground)
- Visual Resource Management
- Recreation
- Military Lands
- Livestock Grazing

- Lands
- Soils
- Vegetation
- Paleontological Resources

3.2 Air Quality

3.2.1 Regulatory Environment

The U.S. Environmental Protection Agency (EPA) Office of Air Quality Planning and Standards and the NDEP have set National Ambient Air Quality Standards (NAAQS) and Nevada ambient air quality standards for the following criteria pollutants: nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), particulate matter smaller than 10 microns in aerodynamic diameter (PM_{10}), particulate matter smaller than 2.5 microns in aerodynamic diameter ($PM_{2.5}$), ozone, and lead. In addition to the above-listed criteria pollutants, NDEP has established an ambient air quality standard for H_2S. Nevada Administrative Code 445B.22097 provides the minimum standards of quality for Nevada ambient air.

Attainment is achieved when the existing background concentrations for criteria air pollutants are less than the maximum allowable ambient concentrations defined in the NAAQS. Nevada is mandated to identify geographic areas that do not meet federal and state air quality standards. The state uses air quality data gathered by monitoring networks to determine the areas within the state not attaining standards. Areas that violate federal or state standards are referred to as "nonattainment areas" for the relevant pollutants.

3.2.2 Affected Environment

The Proposed Action area is located in a sparsely populated rural area with minimal industrial sources or potential impacts to the airshed. Activities associated with the Proposed Action would occur in Groundwater Basin 128 in Churchill County, Nevada. Groundwater basins in the state of Nevada correspond to airsheds and, therefore, Groundwater Basin 128 is the analysis area for air quality. This basin is in attainment for all NAAQS and Nevada air quality standards.

3.2.3 Environmental Consequences

Air emissions from the Proposed Action would occur during construction and operation of the geothermal power plant. Air emissions are also expected from drilling and testing wells. The following summarizes these anticipated air emissions resulting from the Proposed Action.

3.2.3.1 Air Emissions During Construction

The primary pollutants of concern during construction activities would be PM_{10} and $PM_{2.5}$ in the form of fugitive dust. Fugitive dust would be generated from earth-moving activities and vehicle travel on unpaved roads during construction. Fugitive dust emissions would be localized and temporary. To minimize these impacts, TGP would provide dust-control measures throughout construction activities and gravel would be placed on access roads and other work areas to control dust.

Tail-pipe emissions would result from the construction equipment (including drill rigs and support equipment), construction workforce, and delivery vehicles used to access the Proposed Action area. These emissions are expected to be temporary and finite since they

would be generated only during the construction phase of the Proposed Action and would not be expected to cause or contribute to a violation of any federal or state ambient air quality standards.

A Surface Area Disturbance permit from the NDEP-Bureau of Air Pollution Control (NDEP-BAPC) would be required for the construction of the Proposed Action. This permit would specify measures to be implemented for reducing fugitive dust from project construction. These measures may include application of water to actively disturbed areas or soil-binding agents, and use of wind-breaks.

Air Emissions During Operation

Air emissions expected during operation of the proposed geothermal power plant include:

- Greenhouse gas (GHG), $PM_{10}/PM_{2.5}$, and volatile organic compounds (VOC)
- H_2S
- Combustion emissions (NO_2, CO, $PM_{10}/PM_{2.5}$, SO_2, VOCs, and lead)

These emissions are anticipated to be generated by the operation of the geothermal technologies used to produce electricity from the geothermal resources, an emergency diesel fire pump engine, emergency generators located on production pads, and a black-start diesel generator. No air emissions are anticipated from the air-cooled heat rejection system because the systems use air to cool the process steam similar to an automotive radiator. If a hybrid cooling technology is selected, then emissions of H_2S, GHG, $PM_{10}/PM_{2.5}$, and VOC would be expected. Well testing, periodic plant/well maintenance, and upset power plant conditions would also generate H_2S and GHG emissions. Operational air emissions would be regulated by the NDEP-BAPC, which must ensure that air emissions from the Proposed Action do not exceed federal or state ambient air quality standards and comply with applicable regulations.

The Proposed Action would also produce combustion emissions from the operation of an emergency diesel fire pump engine, emergency generators, and black-start generator. Specific sizes and models for these engines are not available, and therefore the potential air emissions cannot yet be estimated. Combustion emissions from the Proposed Action are expected to be minimal because of the limited operation of the fire pump and emergency generators (for monthly operational testing/maintenance and in the case of an emergency) and these engines would be subject to federal emission standards outlined in 40 CFR Part 60 Subpart IIII, 40 CFR Part 60 Subpart JJJJ, and 40 CFR Part 63 Subpart ZZZZ.

TGP would utilize either flash, binary, or combined-cycle technology to produce electricity from the geothermal resource, with the final technology selection made based on the final resource evaluation and construction cost considerations. GHG, H_2S, and VOC emissions may be emitted from the flash, binary, and combined-cycle technologies. The anticipated air emissions from each possible technology to produce electricity from the geothermal resources are described below.

Flash System. Air emissions are generated when the steam used to power the steam turbine generator is condensed. In the condensing process, the steam is cooled to the point it changes from a gas to a liquid. The steam also contains NCGs (e.g., CO_2, H_2S) that are not condensed to a liquid but remain as gases. The NCGs collect in the condenser and require removal by a pump. The pump discharges the NCGs to the atmosphere via cooling fan

shrouds dispersal. Air emissions from the flash systems would be regulated and monitored under a Class I (major) permit issued by the NDEP-BAPC to ensure that ambient air quality standards are not exceeded.

Binary Cycle. The binary cycle would produce the same amount of NCGs as the flash system. In addition, the working fluid used in the binary cycle also produces small amounts of VOC emissions associated with leaks and periodic maintenance operations. These VOC emissions would be periodically vented to a vapor recovery unit for recycling. Emissions from the binary system would be regulated and monitored under a Class I (major) permit issued by the NDEP-BAPC to ensure that ambient air quality standards are not exceeded.

Combined Cycle. The combined-cycle system integrates both the flash and binary systems, therefore, it is expected to emit the same quantity of air emissions as the flash or binary systems. Emissions from the combined-cycle system would also be regulated and monitored under a Class I (major) permit issued by the NDEP-BAPC to ensure that ambient air quality standards are not exceeded.

Well Testing

Small quantities of naturally occurring NCGs, such as H_2S and GHG (carbon dioxide and much smaller amounts of methane) would be emitted to the air during well testing. H_2S initial concentrations in geothermal fluids are estimated at approximately 70 parts per million, and methane concentrations are estimated at less than 2 percent of NCGs, based on historical data (Freeman, 1986). This estimate is conservative in that more recent tests at the existing Dixie Valley Power Plant indicate lower concentrations (TGP, 2009). As discussed in Chapter 2 of this EA, up to 45 (combined production and injection) wells up to 10,000 feet deep would be drilled and performance tested at the site. Well testing would be conducted for an average of 3 days (24 hours per day) for each well. It is anticipated that the initial flow rates of fluid from each well into its reserve pit (and to the existing Dixie Valley Power Plant sumps, as required) would be approximately 500 to 1,500 gallons per minute on average (with up to 700,000 pounds per hour geothermal flow) depending upon the productivity of the well. Based on this estimate, total potential emissions from the proposed well testing would be approximately 2 tons H_2S per well at the site.

Air emission sources that exceed 5 tons per year of criteria air pollutant emissions require an air permit from the NDEP BAPC. The Proposed Action would require a temporary permit because project-related emissions would be greater than 5 tons per year and performance testing would last less than 1 year. If the total activity duration were extended beyond 1 year, TGP would obtain a stationary source permit which would ensure that AAQs are not exceeded.

The measures identified in Section 2 would be taken by TGP to minimize potential impacts to air quality resources during construction, operation, and well testing at the site.

3.3 Cultural Resources

Cultural resources include historic and prehistoric sites of interest and may include structures, archaeological sites, or religious sites of importance to Native American cultures. Section 106 of the National Historic Preservation Act as amended (16 USC 40 et seq.) requires federal agencies to take into account the effects of their actions on properties listed or eligible for listing on the NRHP. The National Park Service (NPS) defines archaeological and historic resources as "the physical evidences of past human activity, including evidences of the effects of that activity on the environment. What makes a cultural resource significant is its identity, age, location, and context in conjunction with its capacity to reveal information through the investigatory research designs, methods, and techniques used by archeologists." Ethnographic resources are defined as any "site, structure, object, landscape, or natural resource feature assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it" (NPS, 1998).

The basic cultural chronology of the western Great Basin includes the Pre-Archaic and Archaic Periods (Elston, 1986). A more thorough background of the prehistoric, historic, and ethnographic resources found in the area can be found in the inventory report conducted for the Proposed Action (Young and Garner, 2009). Below is a very brief summary of these 12,000 years of human occupation in western Nevada.

The Pre-Archaic period is defined by artifacts including Clovis and Folsom fluted lanceolate projectile points and Lake Mojave lanceolate projectile points. Reliance on big game hunting dominated the Pre-Archaic subsistence strategy. The main indicator of the shift to the Archaic period is a change to a broader strategy focused on hunting and gathering of resources. The projectile points became smaller and more suited for hunting smaller game, although they were still mounted on the ends of a dart or spear, and there was an increase in the number and type of stone grinding implements used for plant and seed processing. The material culture diversified greatly with the contemporaneous introduction of pottery and the bow and arrow with smaller projectile points. By around A.D. 1200, an expansion of Numic-speaking peoples into the area seems to have replaced or displaced the previous inhabitants (Bettinger and Baumhoff, 1982). Archaeologically, the primary material culture of the Numic includes Intermountain Brownware pottery and Desert Side Notched and Cottonwood Triangular arrow points. The subsistence strategy appears to have shifted back to a focus on hunting and gathering, although there is some evidence of at least limited reliance on horticulture. The Numic-speaking peoples, including the Northern Paiute, were the occupants of the Great Basin upon the initial arrival of Europeans and their influences.

Cultural resource investigations of the Proposed Action area were conducted in July 2009 (Young and Garner, 2009), June 2010 (Spurling, 2010), and additional investigations occurred in September 2010 (Spurling, 2010). Previously completed investigations included a Class I literature review of both State of Nevada and BLM field office files and a Class III pedestrian inventory of the Proposed Action area.

Forty-seven previously recorded sites were identified within a 1-mile buffer of the Proposed Action area. Most of these sites are small, simple lithic and ground stone scatters. Most of the prehistoric sites are generally located on the gentle alluvial fan on the west side of Dixie Valley. Historic resources previously documented include historic roads, homesteads, and a

borax mine. All previously recorded sites within the Proposed Action area were revisited during the cultural resource surveys conducted for the Proposed Action.

3.3.1 Affected Environment

Portions of the Proposed Action area were surveyed for cultural resources, either by Far Western (Young and Garner, 2009), SWCA Environmental Consultants (Spurling, 2010), or by other recent investigations in the area for small geothermal exploration or testing projects (McGuire, 1993). Additional surveys for the remainder of the project area occurred in September 2010. To date, seventeen cultural resource sites have been identified in the Proposed Action area, two of which were combined into one site based on the recommendations of the cultural resources study, resulting in a total of 16 cultural resource sites. Prehistoric sites dominate the assemblage; one historic site was identified during a previous investigation (McGuire, 1993). The historic site consists of a small-scale mining venture with associated artifacts and was previously recommended as not eligible. The site was reexamined and updated during the current inventory and is recommended as not eligible to the NRHP (Young and Garner, 2009).

Of the remaining 15 cultural resource sites, six prehistoric sites have been determined to be eligible for listing to the NRHP based on the potential to yield data that would contribute to the understanding of the prehistoric occupation of the area. All recommendations for site eligibility for listing on the NRHP are based on preliminary field recommendations and are subject to review and possible changes during BLM and State Historic Preservation Office (SHPO) consultations.

3.3.2 Environmental Consequences

The Proposed Action currently has the potential to impact six archeological sites recommended as eligible for NRHP listing within the project area. To avoid impacts, the Proposed Action would implement the proposed mitigation measures identified in Section 2.1.1.3 and avoid archeological sites recommended eligible for NRHP listing.

Consultation with the SHPO on Determinations of Eligibility and Finding of Effect for cultural resources located within the Proposed Action area is ongoing. Construction and operation of the Proposed Action would avoid all known resources identified during the survey activities in accordance with the State Protocol Agreement between the BLM and the SHPO for Implementing the National Historic Preservation Act, 2009, Appendix G., Sections A and B (BLM and SHPO, 2009).

Construction of the Proposed Action also has the potential to affect undiscovered or subsurface resources.

Based on the avoidance of known sites and the established protocol for the discovery of any new site, there would be no impact on cultural resources.

No impacts would occur during decommissioning. Only previously disturbed areas would be disturbed during decommissioning. All cultural sites would be avoided. Adverse effects would not occur.

3.4 Invasive, Nonnative, and Noxious Species

3.4.1 Affected Environment

The State of Nevada lists 47 noxious weed species that require control (Nevada Administrative Code 555.10; Nevada Department of Agriculture, 2008). Of these, saltcedar (*Tamarix ramosissima*) was the only noxious weed identified in the Proposed Action area during field surveys. In addition, the following invasive, non-native species were identified within or in the vicinity of the Proposed Action area: Russian olive (*Elaeagnus angustifolia*), cheat grass (*Bromus tectorum*), Russian thistle (*Salsola kali*), and common sowthistle (*Sonchus oleraceus*).

3.4.2 Environmental Consequences

The Proposed Action has the potential to increase the spread of invasive, non-native, and noxious species. Seeds can germinate when soils are disturbed by construction and drilling activities, particularly where soil moisture is increased by applying water for dust suppression. Construction equipment brought to the project from infested areas and using seed mixtures or mulching materials that contain undesirable seeds could also introduce non-native and noxious species into the area. Power plant operations would have less likelihood of increasing the spread of invasive, non-native and noxious species because vehicles would use access roads for travel.

The potential for the Proposed Action to increase the spread of invasive, non-native and noxious plants species would be minimized by using measures described in Section 2.1.1.3, including mapping and treating weed infestations prior to disturbance or during construction, using certified weed-free seed and mulching materials, and washing heavy equipment prior to entering public lands. Additionally, a noxious plant control program would be implemented. By using these measures, no long-term impacts associated with invasive, non-native, and noxious species are expected to occur from the Proposed Action.

3.5 Migratory Birds

3.5.1 Affected Environment

On January 11, 2001, President Clinton signed Executive Order 13186 (EO) placing emphasis on the conservation and management of migratory birds. Migratory birds are protected under the Migratory Bird Treaty Act of 1918 (MBTA), and the EO addresses the responsibilities of federal agencies to protect migratory birds by taking actions to implement the MBTA. BLM management for migratory bird species on BLM-administered lands is based on Instruction Memorandum No. 2008-050 (BLM, 2007b). Based on this Instruction Memorandum, migratory bird species of conservation concern include "Species of Conservation Concern" and "Game Birds Below Desired Conditions." These lists were updated in 2008 (USFWS, 2008a).

3.5.1.1 Golden Eagle

The Bald and Golden Eagle Protection Act (1940 as amended 1959, 1962, 1972, 1978) prohibits the take or possession of bald and golden eagles with limited exceptions. ***Take***, as defined in the Eagle Act, includes "to pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb." ***Disturb*** means "to agitate or bother a bald or golden eagle to a degree that causes or is likely to cause, based on the best scientific information available, (1) injury to an eagle, (2) a decrease in its productivity, by substantially interfering with normal breeding, feeding or sheltering behavior, or (3) nest abandonment, by substantially interfering with normal breeding, feeding or sheltering behavior."

Important eagle-use area is defined in the Eagle Act as an eagle nest, foraging area, or communal roost site that eagles rely on for breeding, sheltering, or feeding, and the landscape features surrounding such nest, foraging area, or roost site are essential for the continued viability of the site for breeding, feeding, or sheltering eagles.

BLM requires consideration and NEPA analysis of golden eagles and their habitat for all renewable energy projects (BLM Instruction Memorandum No. 2010-156). Golden eagles use Dixie Valley for foraging and the nearby mountain ranges for nesting, but no documented nests are within 6 miles of the lease area (NDOW, 2010a).

Key habitats found within the Proposed Action area that support life requisites of migratory birds are described in detail in Section 3.7, Wildlife.

Table 3-3 lists migratory birds potentially present at the CC lease area.

TABLE 3-3
Migratory Bird Species of Concern, Habitat Association, and Presence/Absence of Suitable Habitat at the CC Lease Area

Common Name	Scientific Name	Habitat Association	Presence/Absence of Suitable Habitat
Game Birds of Conservation Concern			
Dove, mourning	*Zenaida macroura*	Open woodland, forest edge, cultivated lands with scattered trees and bushes, parks and suburban areas, arid and desert country and second growth.	Present
Bird Species of Conservation Concern			
Blackbird-tricolored	*Agelaius tricolor*	Breeds near fresh water, preferably in emergent wetlands, with tall, dense cattails or tules, but also in thickets of willow, blackberry, wild rose, and tall herbs. Feeds in grassland and cropland habitats.	May be present
Eagle, golden	*Aquila chrysaetos*	Generally open country, in prairies, arctic and alpine tundra, open wooded country, and barren areas, especially in hilly or mountainous regions.	Present; observed at existing Dixie Valley Power Plant
Falcon, prairie	*Falco mexicanus*	Primarily open situations, especially in mountainous areas, steppe, plains or prairies.	Present; observed in Coyote Canyon
Finch, black rosy	*Leucosticte atrata*	Breeds in alpine areas, usually near rock piles, and cliffs. Winters in open country, including mountain meadows, high deserts, valleys, and plains	May be present
Flycatcher, willow	*Empidonax traillii*	Breeds in moist, shrubby areas, often with standing or running water. Winters in shrubby clearings and early successional growth.	May be present
Harrier, northern	*Circus cyaneus*	Marshes, meadows, grasslands, and cultivated fields.	May be present
Hawk, ferruginous	*Buteo regalis*	Grasslands and semidesert shrublands; nest in isolated trees, on rock outcrops, or ground	Present
Hummingbird, calliope	*Stellula calliope*	Open montane forest, mountain meadows, and willow and alder thickets, in migration and winter also in chaparral, lowland brushy areas, deserts and semi-desert regions.	May be present
Owl, burrowing	*Athene cunicularia*	Open dry shrub/steppe grasslands, agricultural and rangelands, and desert habitats associated with burrowing animals.	Present
Shrike, loggerhead	*Lanius ludovicianus*	Open county with scattered trees and shrubs, savanna, desert scrub, and occasionally open woodland.	Present; observed in lease area

TABLE 3-3
Migratory Bird Species of Concern, Habitat Association, and Presence/Absence of Suitable Habitat at the CC Lease Area

Common Name	Scientific Name	Habitat Association	Presence/Absence of Suitable Habitat
Sparrow, black-chinned	*Spizella atrogularis*	Dry, brushy chaparral in rocky, rugged landscapes in habitats characterized by sagebrush, greasewood, chamise, mesquite, cactus, and other arid scrub plants.	
Sparrow, Brewer's	*Spizella breweri*	Strongly associated with sagebrush over most of range, in areas with scattered shrubs and short grass.	Present
Sparrow, sage	*Amphispiza belli*	Strongly associated with sagebrush for breeding; also found in saltbush brushland, shadscale, antelope brush, rabbitbrush, black greasewood, mesquite, and chaparral.	Present
Swift, black	*Cypseloides niger*	This is a species that breeds in mountainous areas, but ranges far from nesting sites to forage.	Foraging habitat may be present
Thrasher, sage	*Oreoscoptes montanus*	Found in relatively undisturbed shrub-steppe habitats within areas of tall/dense big sagebrush.	May be present
Towhee, green-tailed	*Pipilo chlorurus*	Dry, shrubby hillsides. Breeds in areas with a high diversity of shrub species providing dense, low cover. During migration and winter, it is found in similar habitats, often near streams.	May be present
Vireo, Gray	*Vireo vicinior*	Inhabits hot, semi-arid, shrubby habitats.	Present
Warbler, Virginia's	*Vermivora virginiae*	Preferred breeding habitat includes chaparral; open stands of pinyon-juniper, yellow pine, and scrub oak; mountain mahogany thickets and other low brushy habitats on dry mountainsides; open ravines and canyons; and flat mountain valley bottoms.	May be present

3.5.2 Environmental Consequences

Construction of a power plant, gen-tie, well connection pipelines, and surface disturbance from roads, parking, and laydown areas would result in permanent, direct loss of cold desert scrub habitat that sagebrush breeders such as sage thrasher, sage sparrow, and Brewer's sparrow, also utilize as support habitat. The gen-tie and towers associated with drilling also could result in direct mortality from bird strikes. Indirect temporary effects from noise, human presence, and heavy equipment present during construction activities may lead to reduced nesting success for individuals that are not displaced but are affected by the fragmentation and/or overall footprint of the project, or to individuals being

displaced into surrounding areas. This in turn may affect foraging opportunities for species that prey on adults, nestlings, or eggs. Raptor species, such as prairie falcon, that prey on rodents and lizards also may be affected by these activities.

Direct and indirect effects from permanent noise associated with a power plant or pipeline pumps affect species differently. For example, birds with higher-frequency calls were less likely to avoid roadways than birds with lower-frequency calls (Barber et al. 2009, and references therein).

However, because of the minimal extent of noise effects from the power plant, the low decibels emanating from the pipeline pumps (BLM regulations mandate that noise at one-half mile—or at the lease boundary if closer—from a major geothermal operations shall not exceed 65 A-weighted decibels (43 CFR 3200.4[b])), and the small habitat acreage loss (134 acres) relative to the hundreds of thousands of acres of available cold desert scrub habitat in Dixie Valley, population viability for any one species is not expected to be in jeopardy as a result of the components of the Proposed Action. Installing perch deterrents and bird diverters on the gen-tie and conducting pre-construction migratory bird nest surveys would minimize and/or eliminate impacts on individual birds by minimizing avian collisions with transmission facilities and preventing electrocution. Additionally, because no known golden eagle nests are within 6 miles of the project area, there are hundreds of thousands of acres of available cold desert scrub habitat for foraging in Dixie Valley, and negligible prey impacts, no "Take" or disturbance to "Important Eagle Use Areas" is reasonably expected.

3.6 Wildlife

3.6.1 Affected Environment

Based on the Southwest Regional GAP Analysis Project, the Nevada Department of Wildlife's Wildlife Action Plan (2006) characterized Nevada's vegetative land cover into eight broad ecological system groups and linked those with Key Habitat types, which are further refined into Ecological Systems characterized by plant communities or associations (USGS, 2005). Along with survey data, Key Habitats can be used to infer likely occurrences of wildlife species assemblages. Key Habitat types that potentially would be affected directly or indirectly by the Proposed Action are Cold Desert Scrub and Desert Playas and Ephemeral Pools. The latter includes several minor wetlands created from seeps stemming from historical seismic exploration drilling (Section 3.13, Wetlands/Riparian Zones). When playas contain water for extended periods of time, lush vegetation can grow in addition to producing many aquatic invertebrates that provide forage for shorebirds, waterfowl, and small water birds. However, the playa area adjacent to the CC lease area does not contain a large permanent water source; therefore, it does not currently and is unlikely in the future to contribute this kind of permanent wildlife habitat within the influence of the Proposed Action.

Wildlife found during field surveys conducted in June, July, and August 2009 in the CC lease area is typical of these habitats. Wildlife species observed included various birds (see Section 3.6, Migratory Birds), coyote (*Canis latrans*), black-tailed jackrabbit (*Lepus californicus*), cottontail (*Sylvilagus* spp.), white-tailed antelope squirrel (*Ammospermophilus leucurus*), desert horned lizard (*Phyrnosoma platyrhinos*), zebra-tailed lizard (*Callisaurus draconoides*), western whiptail (*Aspidoscelis tigris*), side-blotched lizard (*Uta stansburiana*), long-nosed leopard lizard (*Gambelia wislizenii*), and mule deer (*Odocoileus hemionus*) (CH2M HILL, 2009a). Although no bat roosting habitat is found in the CC lease area, habitat is found in mines, caves, and rock crevices of the Stillwater Range, and bats may use the area for foraging.

3.6.1.1 Big Game

Big game species that may travel from the Stillwater Range to the west through the CC lease area to the Clan Alpine Mountains to the east largely consist of mule deer (*Odocoileus hemionus*), mountain lion (*Feliz concolor*), and desert bighorn sheep (*Ovis canadensis nelsoni*).

3.6.2 Environmental Consequences

Construction of a power plant, gen-tie, well connection pipelines, and surface disturbance from roads, parking, and laydown areas would result in permanent direct loss of habitat and potential mortality for lizards and small mammals that forage and/or have burrow complexes within the cold desert scrub habitat. Indirect effects from noise, human presence, and heavy equipment present during construction activities may lead to reduced breeding success for individuals that are not displaced but are affected by the fragmentation of the overall footprint of the project, or to individuals being displaced into surrounding areas. This in turn may affect distribution of large mammals and raptors that forage on rodents and small mammals.

Direct and indirect effects from permanent noise associated with a power plant or pipeline pumps affect species differently. For example, bats (e.g., pallid bat) that find their prey from noise that the prey makes instead of echolocation have been shown to avoid noisy areas. Bats using echolocation were unaffected because those ultrasonic signals are above the spectrum of human noise. Rodents that use chirps to warn of predators may be susceptible to increased predation because these chirps may be masked from the power plant noise (Barber et al., 2010). Big game species may avoid the area when traveling between mountain ranges.

However, because of the minimal extent of noise effects from the power plant, the low decibels emanating from the pipeline pumps (up to 65 decibels per BLM guidelines), and the small habitat acreage loss (134 acres) relative to the hundreds of thousands of acres of available cold desert scrub habitat in Dixie Valley, population viability for any one species is not expected to be in jeopardy as a result of the components of the Proposed Action. Additionally, game species would not reasonably incur additional physiological stress leading to decreased survival by avoiding the CC lease area when crossing between mountain ranges.

3.7 Special-status Species – BLM Sensitive

Sensitive species are defined in BLM Manual 6840 (Special Status Species Management) as native species found on BLM-administered lands for which the BLM has the capability to significantly affect the conservation status of the species through management and either one of the following:

1. There is information that a species has recently undergone, is undergoing, or is predicted to undergo a downward trend such that the viability of the species or a distinct population segment of the species is at risk across all or a significant portion of the species range; or
2. The species depends on ecological refugia or specialized or unique habitats on BLM-administered lands, and there is evidence that such areas are threatened with alteration such that the continued viability of the species in that area would be at risk (BLM, 2008b).

3.7.1 Affected Environment

A list of sensitive species associated with BLM administered lands in Nevada was signed in 2003 (BLM, 2003). Table 3-4 presents BLM-designated Sensitive Species and their habitat association within the CC lease area.

Key habitats found within the CC lease area that support life requisites of BLM-designated Sensitive Species are described in detail in Section 3.7, Wildlife.

TABLE 3-4
Nevada BLM Sensitive Species, Habitat Association, and Presence/Absence of Suitable Habitat in the CC Lease Area

Common Name	Scientific Name	Habitat Association	Presence/Absence of Suitable Habitat
Golden eagle	*Aquila chrysaetos*	Generally open country, in prairies, arctic and alpine tundra, open wooded country, and barren areas, especially in hilly or mountainous regions	Present; observed at existing Dixie Valley Power Plant
Ferruginous hawk	*Buteo regalis*	Grasslands and semidesert shrublands; nest in isolated trees, on rock outcrops, or ground	Present
Swainson's hawk	*Buteo swainsoni*	Found in open grassland steppe areas, but typically requires scattered trees for nesting.	May be present
Prairie falcon	*Falco mexicanus*	Primarily open situations, especially in mountainous areas, steppe, plains or prairies.	Present; observed in Coyote Canyon
Burrowing owl	*Athene cunicularia*	Open dry shrub/steppe grasslands, agricultural and rangelands, and desert habitats associated with burrowing animals	Present

TABLE 3-4
Nevada BLM Sensitive Species, Habitat Association, and Presence/Absence of Suitable Habitat in the CC Lease Area

Common Name	Scientific Name	Habitat Association	Presence/Absence of Suitable Habitat
Short -eared owl	*Asio flammeus*	Marshland and open grasslands, tundra, open fields, forest clearings, sagelands, deserts, pastures, prairies, lower mountain slopes, canyons, arroyos, dunes, meadows, and coastal salt marshes. The primary requirement of any habitat is an abundance of prey.	May be present
Long -eared owl	*Asio otus*	Dense vegetation adjacent to open grassland or shrubland, and open forests.	May be present
Juniper titmouse	*Baeolophus griseus*	Warm, dry open woodland, especially juniper woodlands.	
Loggerhead shrike	*Lanius ludovicianus*	Open county with scattered trees and shrubs, savanna, desert scrub, and occasionally open woodland.	Present; observed in CC lease area
Vesper sparrow	*Pooecetes gamineus*	Plains, prairie, dry shrub lands, savanna, weedy pastures, fields, sagebrush, arid scrub and woodland clearings	Present
Tricolored blackbird	*Agelaius tricolor*	Breeds near fresh water, preferably in emergent wetlands, with tall, dense cattails or tules, but also in thickets of willow, blackberry, wild rose, and tall herbs. Feeds in grassland and cropland habitats.	May be present
Black rosy finch	*Leucostricte atrata*	Breeds in alpine areas, usually near rock piles, and cliffs. Winters in open country, including mountain meadows, high deserts, valleys, and plains	May be present
Gray vireo	*Vireo vicinior*	Inhabits hot, semi-arid, shrubby habitats	Present
Western pipistrelle bat	*Pipistrellus hesperus*	Deserts and lowlands, desert mountain ranges, desert scrub flats, and rocky canyons	Present
Pallid bat	*Antrozous pallidus*	Arid deserts and grasslands, often near rocky outcrops and water	Present
Spotted bat	*Euderma maculatum*	Found in various habitats from desert to montane coniferous stands, including open ponderosa pine, pinyon-juniper woodland, canyon bottoms, open pastures, and hayfields	Present
Yuma myotis	*Myotis yumanensis*	More closely associated with water than most North American bats. Found in a variety of upland and lowland habitats, including riparian, desert scrub, moist woodlands and forests, but usually found near open water.	May forage in Proposed Action area

TABLE 3-4
Nevada BLM Sensitive Species, Habitat Association, and Presence/Absence of Suitable Habitat in the CC Lease Area

Common Name	Scientific Name	Habitat Association	Presence/Absence of Suitable Habitat
Western red bat	*Lasiurus blossevilli*	Riparian habitats dominated by cottonwoods, oaks, sycamores, and walnuts; rarely found in desert habitats. Summer roost usually in tree foliage.	May forage in Proposed Action area but unlikely.
Silver-haired bat	*Lasionycteris noctivagans*	Prefers forested (frequently coniferous) areas adjacent to lakes, ponds, and streams	May forage in CC lease area
Townsend's big-eared bat	*Corynorhinus townsendii*	Maternity and hibernation colonies typically are in caves and mine tunnels	May forage in CC lease area
Big brown bat	*Eptesicus fuscus*	Various wooded and semi-open habitats, including cities	Present
Hoary bat	*Lasiurus cinereus*	Prefers deciduous and coniferous forests and woodlands.	May forage in CC lease area
Brazilian free-tailed bat	*Tadarida braziliensis*	Roosts primarily in caves	May forage in CC lease area
Long-eared myotis	*Myotis evotis*	Mostly forested areas, especially those with broken rock outcrops; also shrubland, over meadows near tall timber, along wooded streams, over reservoirs	May forage in CC lease area
Fringed myotis	*Myotis thysanodes*	Primarily at middle elevations for 1,200-2,150 meters in desert, grassland, and wooded habitats	Present
California myotis	*Myotis californicus*	Western lowlands; sea coast to desert, oak-juniper, canyons, riparian woodlands, desert scrub, and grasslands	Present
Small-footed myotis	*Myotis ciliolabrum*	Generally inhabits desert, badland, and semiarid habitats	Present
Little brown myotis	*Myotis lucifugus*	Adapted to using human-made structures for resting and maternity sites, also uses caves and hollow trees; foraging habitat is generalized, usually in woodlands near water	May forage in CC lease area
Long-legged myotis	*Myotis volans*	Primarily in montane coniferous forests; also riparian and desert habitats	May forage in CC lease area
Desert bighorn sheep	*Ovis canadensis nelsoni*	Steep slopes on or near mountains with a clear view of surrounding area	Present in Stillwater Range western portion of Proposed Action area
Pallid wood nymph	*Cercyonis oetus pallescens*	Alkaline flats	Present
Sand Mountain blue	*Euphilotes pallescens arenamontana*	No data	Present; known to occur within Dixie Valley

TABLE 3-4
Nevada BLM Sensitive Species, Habitat Association, and Presence/Absence of Suitable Habitat in the CC Lease Area

Common Name	Scientific Name	Habitat Association	Presence/Absence of Suitable Habitat
Nevada dune beardtongue	*Penstemon arenarius*	Deep, volcanic, sandy soils at 1,200-1,350 meter elevation; common associates include fourwing saltbush, littleleaf horsebrush, and greasewood	Potentially present; not known to occur in Dixie Valley
Lahontan beardtongue	*Penstemon palmeri* var. *macranthus*	Along washes, roadsides, and canyon floors, particularly on carbonate-containing substrates, usually where subsurface moisture is available throughout most of the summer; unknown if restricted to calcareous substrates	Present; known to occur within Dixie Valley

3.7.2 Environmental Consequences

Consequences are the same for BLM-designated Sensitive Species as are described for migratory birds and wildlife in Sections 3.6 and 3.7, respectively. Construction of a power plant, gen-tie, well connection pipelines, and surface disturbance from roads, parking, and laydown areas would result in permanent direct loss of foraging and nesting habitat, as well as potential mortality for some species that may collide with the gen-tie and towers associated with drilling operations. Indirect effects from noise, human presence, and heavy equipment present during construction activities may lead to reduced breeding success for individuals that are not displaced but are affected by the fragmentation of the overall footprint of the project, or to individuals being displaced into surrounding areas. This in turn may affect distribution of raptors that forage on rodents and small mammals.

Direct and indirect effects from permanent noise associated with a power plant or pipeline pumps affect species differently. For example, bats (e.g., pallid bat) that find their prey from noise that the prey makes instead of echolocation have been shown to avoid noisy areas. Bats using echolocation were unaffected because those ultrasonic signals are above the spectrum of human noise. Rodents that use chirps to warn of predators may be susceptible to increased predation because these chirps may be masked from the power plant noise (Barber et al., 2010). Noise stemming from drilling operations would be temporary. Desert bighorn sheep may avoid the area when traveling between mountain ranges.

However, because of the minimal extent of noise effects from the power plant, the low decibels emanating from the pipeline pumps (up to 65 decibels per BLM guidelines), and the small habitat acreage loss (134 acres) relative to the hundreds of thousands of acres of available cold desert scrub habitat in Dixie Valley, population viability for any one species is not expected to be in jeopardy as a result of the components of the Proposed Action. Additionally, desert bighorn sheep would not reasonably incur additional physiological stress leading to decreased survival by avoiding the Proposed Action area when crossing between mountain ranges.

3.8 Native American Religious Concerns

3.8.1 Affected Environment

Consultation was initiated with the Fallon Paiute-Shoshone Tribe on July 6, 2009. Correspondence provided the results of the initial cultural resources inventory and subsequent final report (October 27 and November 30, 2009). Face-to-face meetings were conducted between the BLM and tribal staff on January 12, 2010, and August 25, 2010. Correspondence included a description of the Proposed Action, cultural resource reports, and a map.

3.8.2 Environmental Consequences

Consultation regarding the Proposed Action area between the BLM and federally recognized Native American tribes is ongoing. During consultation for the Proposed Action, cultural resources including historic properties and other resources were identified and potentially may be affected by the Proposed Action.

Archaeological sites can and would be avoided through project design. If human remains are identified during construction of any of the components of the Proposed Action, work within 300 feet of the discovery would be stopped and the remains would be protected from further exposure or damage. If the remains are determined to be Native American, the agencies would follow the procedures set forth in 43 CFR Part 10, Native American Graves Protection and Repatriation Regulations.

3.9 Wastes, Hazardous or Solid

3.9.1 Affected Environment

No hazardous wastes or hazardous materials are known to occur in the CC lease area. Numerous federal and state laws and regulations have been enacted and are enforced by the NDEP Bureau of Waste Management to ensure that hazardous materials, hazardous waste and solid wastes are properly handled, stored, and disposed. There are no existing landfills located within the CC lease area. The nearest landfill is located in Lovelock, Nevada, approximately 30 miles from the CC lease area.

3.9.2 Environmental Consequences

Diesel fuel, lubricants, hydraulic fluids, and drilling chemicals (e.g., drilling mud, caustic soda, barite, scale inhibitors) would be transported to, stored on, and used at the project site. If a binary or combined-cycle unit is selected for power generation, a secondary organic working fluid, such as pentane (C_5H_{12}), isopentane (C_5H_{12}), butane (C_4H_{10}), isobutane (C_4H_{10}) or a refrigerant such as R245fa would be used in a closed system.

The Proposed Action must conform to federal and state requirements for handling these hazardous materials. The storage and use of these materials could result in minor, incidental spills of diesel fuel or oil to the ground during fueling of equipment, filling of fuel storage tanks, and handling lubricants. Other incidental spills could be associated with equipment failures such as ruptured hoses. BMPs presented in Section 2.1.1.3 including development of an SPCC plan, use of secondary containment structures, and worker training would be used to prevent the release of hazardous wastes to the environment.

Wastes (solid and liquid) would be transported offsite for appropriate disposal consistent with state and federal regulatory requirements. The Proposed Action would generate minimal levels of hazardous waste and would be classified as a Conditionally Exempt Small Quantity Generator under federal regulations. Implementation of these procedures would prevent or minimize potential impacts on the environment from project-related hazardous or non-hazardous wastes.

3.10 Geology and Minerals

3.10.1 Affected Environment

The non-mountainous portions of the CC lease area, where wells would be installed as part of the Proposed Action, are located at elevations ranging from approximately 3,400 feet to 3,600 feet in the northern part of Dixie Valley. Dixie Valley is a north-northeast/south-southwest-trending elongated valley in west-central Nevada, within the Great Basin Section of the Basin and Range Physiographic Province. The western edge of Dixie Valley is defined by the Stillwater Range and the eastern edge is defined by the Clan Alpine Mountains. Alluvial fans and pediment surfaces flank the area between the mountains and the valley interior. The Proposed Action is located on alluvial fans at the base of the Stillwater Range on the western edge of Dixie Valley.

Wells at the existing Dixie Valley plant (Figure 3-1) have penetrated marine siltstone, shale, sandstone, and volcaniclastic rocks exposed in the Stillwater Range (Bruton et al., 1997). A sequence of Triassic tuff, andesite, and Miocene basalt (tertiary basalt and tuff) overlies older sedimentary and igneous rocks (basement or down-dropped basement) at a depth of approximately 7,000 to 8,000 feet within Dixie Valley. It is overlain by a 1,500- to 4,000-foot-thick sequence of late Tertiary basin-fill sediments, including lacustrine, playa, and alluvial fan sediments (valley fill). Figure 3-2 shows the location of the geologic cross section. The cross section depicts a sequence of faults associated with the down-dropped basement rocks underlying Dixie Valley near the Senator Fumaroles, immediately north of the CC lease area. Structurally, Dixie Valley is an elongated down-dropped block, or graben, bounded by high-angle faults of Holocene age (Ryall and Vetter, 1982). The faulting associated with the geothermal reservoir is located beneath the west valley edge at the base of the Stillwater Range. Figure 3-3 is a map that shows the approximately locations of the faults in Dixie Valley and the location of the Proposed Action.

Seismic activity subsequent to the tectonism that formed the Dixie Valley graben has further deformed the bedrock, resulting in a complex series of faults in the bedrock beneath the valley floor near the Stillwater Range front (Smith, et al. 2001). Dixie Valley is located in an active seismic area. A major earthquake of magnitude 6.8 occurred in 1954 beneath Dixie Valley and created a visible scarp along the portions of the west margin of Dixie Valley (Ryall and Vetter, 1982).

Precious metals have historically been mined in the Clan Alpine Mountains bordering Dixie Valley. Existing mines in Churchill County are located around its periphery, far from Dixie Valley, which is situated in the central part of the county. Based on a review of existing mines (Willden and Speed, 1974) and the online Mineralogy Databases (Mindat.org, 2010), there are no current commercial industrial mining operations in Dixie Valley. There are currently 100 active unpatented lode mining claims within Township 24N, Range 26E. There is a material community pit near the Proposed Action area in Township 24N, Range 36E, Section 16.

3.10.2 Environmental Consequences

A history of recent (1954) seismicity associated with the Dixie Valley fault zone led Ryall and Vetter (1982) to suggest that Dixie Valley would have a potential for induced seismicity if injection of geothermal fluids into deep wells occurs. Induced seismicity is associated most commonly with high-pressure injection of either wastewater (such as at Rocky Mountain Arsenal in Colorado) or water into dry or steam-dominated thermal rock zones, such as at The Geysers in California (Ryall and Vetter, 1982, and Bromley and Mongillo, 2008). This latter practice, in which otherwise water-limited or non-water bearing hot rocks are artificially fractured using high-pressure fluids, can induce seismicity during the hydraulic fracturing stage and during the long-term operations stage. Induced seismicity is not expected to be associated with the Proposed Action because hydraulic fracturing technology is not planned for use and because the geothermal fluid withdrawal/injection process would be conducted in a manner intended to maintain relatively consistent pressures rather than to dramatically increase (or decrease) pore water pressures in the geothermal reservoir as occurs by design with high-pressure injection intended to induce fracturing. The current injection system at the existing Dixie Valley geothermal facility has not caused any significant seismicity issues, and given the close proximity to the Proposed Action area, the Proposed Action is not expected to have any increase in seismicity.

The Proposed Action does not involve mineral extraction and would not affect current or anticipated future mineral exploration, extraction or processing activities beyond the physical impediment presented by project infrastructure (roads, pipelines, drill pads and appurtenant features).

3.11 Water Resources (Surface/Ground)

3.11.1 Surface Water

3.11.1.1 Affected Environment

Based on analysis of U.S. Geological Survey (USGS) topographic maps, Nevada Division of Water Resources groundwater basin mapping, and on wetland field surveys conducted March 26–April 1, 2010 (CH2M HILL, 2010), the Proposed Action would be located in an internally drained desert basin that is a great distance from and lacks hydrographic connectivity to major rivers and water bodies. Therefore, there are no navigable waters of the U.S. within Rivers and Harbors Act jurisdiction (as defined by 33 CFR part 329) and no waters of the U.S. within Clean Water Act jurisdiction (as defined by 33 CFR 328) in the CC project area. A formal wetland delineation was conducted by CH2M HILL on March 26–April 1, 2010. This delineation also concluded that the basin is internally drained and contains no waters of the U.S. within Clean Water Act jurisdiction.

No ponds or wetlands exist within the CC project site. The USGS 7.5-minute topographic map of the area (Bolivia, Nevada Quadrangle 1990) shows ephemeral washes flowing southeast across the alluvial fan and valley bottom within the CC lease area and into the Humboldt Salt Marsh within Dixie Valley. These ephemeral washes only flow from significant rainfall or snowmelt events.

No springs or seeps have been mapped within the lease area.

3.11.1.2 Environmental Consequences

No effect on surface water resources is expected because of the lack of surface water resources in the Proposed Action area.

3.11.2 Groundwater

3.11.2.1 Affected Environment

The CC lease area is located in the internally drained Dixie Valley groundwater basin (Nevada Division of Water Resources-designated Administration Groundwater Basin 128). Dixie Valley is located in Nevada Hydrographic Region 10 (Central Region) (Nevada Division of Water Resources, 2005) and is in the Great Basin hydrographic area.

Groundwater Basin 128 has an area of 1,303 square miles and a perennial yield of 15,000 afy. The basin has committed underground water rights of 18,076 afy and geothermal water rights of 13,428 afy (Nevada Division of Water Resources, 2009). By Order 715, dated June 8, 1978, the Nevada State Engineer has "designated" the Dixie Valley groundwater basin, which indicates that the permitted groundwater rights approach or exceed the estimated average annual recharge and the water resources are being depleted or require additional administration (Nevada Division of Water Resources, 2009).

In Dixie Valley, groundwater generally occurs in the alluvial basin fill sediments and in the underlying bedrock. In the northern portion of Dixie Valley, where the CC project area is located, groundwater moves south through the valley, east from the Stillwater Mountains, and west from the Clan Alpine Mountains. Recharge to groundwater occurs from precipitation,

primarily snowmelt, at higher elevations in the Stillwater Range and Clan Alpine Range west and east of Dixie Valley and in the alluvial fans and landslide deposits at the base of these mountains. The Humboldt Salt Marsh (playa) is the ultimate groundwater sink for Dixie Valley and six subbasins that are adjacent to Dixie Valley (Fairview, Pleasant, Jersey, Eastgate, Cowkick, and Stingaree valleys). Groundwater flows away from the surrounding mountains and toward the center of the valley and discharges on the playa. Groundwater moves vertically upward in the central part of the valley, in response to hydraulic gradients, where it discharges to the playa and is lost to evaporation and transpiration.

Shallow Groundwater

Groundwater occurs in two separate aquifer systems in Dixie Valley: a shallow, non-thermal, alluvial aquifer system and a deep, thermal, bedrock aquifer system (Karst, 1987). Groundwater in the alluvium occurs under both unconfined and confined conditions. Hydraulic heads for confined conditions are typically beneath the elevation of the valley floor (Nevada Division of Water Resources, 2010). TGP Dixie Development Company well files for geothermal wells 66-21 and 62-23 in the CC lease describe valley fill deposits as undifferentiated Quaternary alluvium to depths of approximately 4,300 feet (Figure 3-4).

The majority of wells located within 1 mile of the CC lease area were dry (Nevada Division of Water Resources, 2010) with total depths ranging from 105 to 495 feet (Table 3-5 and Figure 3-4). Wells that did encounter water had total depths ranging from 50 to 1,500 feet deep. The varying degrees of saturation and confinement observed in shallow aquifer water wells are the result of the complex depositional environment of the valley fill sediments along with post-deposition deformation. Consequently, this has led to a complex sequence of variably saturated, water-bearing zones and intervals of unsaturated interbedded low-permeability confining layers (Nimz et al., 1999).

Limited information is available on the hydraulic characteristics of basin fill water-bearing zones. The record of one well located in the CC lease area (Nevada state well number 21293) (Figure 3-4) indicates that it is 300 feet deep and was tested for 48 hours at a pumping rate of 300 gallons per minute, after which it exhibited 180 feet of drawdown, for a specific capacity of about 1.7 gallons per minute per foot of drawdown (Nevada Division of Water Resources, 2010). Using the confined aquifer empirical Jacob's approximation method (Driscoll, 1986), this specific capacity value correlates to an estimated transmissivity of 3,300 gallons per day per foot (gpd/ft) and translates to an average hydraulic conductivity of about 330 gallons per day per square foot (40 feet per day or 0.016 centimeter per second) for the lower of the two water-bearing intervals tapped by the well (assuming the upper zone was temporarily dewatered during the pumping test). Because of the nature of the alluvial deposits (interbedded and interfingering sand, silt, and clay), the bulk vertical permeability within the alluvial basin fill is expected to be much lower than the bulk horizontal permeability.

TABLE 3-5
Existing Wells Located Within One Mile of the CC Lease

Log Number	Township	Range	Section	Quarter, Quarter Section	Date Completed	Total Depth (ft)	Static Water Level (ft bgs)	Casing Diameter (in.)
21891	N24	E36	13	NW NE	11/4/1976	105	NA	NA
21892	N24	E36	21	SE NE	11/6/1976	345	NA	NA
21893	N24	E36	16	NE SE	5/14/1979	1,500	150.00	1
21894	N24	E36	21	SE NW	4/9/1978	200	NA	1
21895	N24	E36	28	SE NW	12/19/1976	495	NA	NA
21897	N24	E36	28	NW NW	11/5/1976	300	NA	1.25
22821	N24	E36	21	NW SE	9/28/1979	7,195	NA	7
43262	N24	E36	23	NW NE	12/13/1993	11,778	NA	13.38
47412	N24	E36	14	NE SW	10/2/1994	11,713	NA	13.38
21293	N24	E36	12	NE SE	6/1/1974	300	125	16
21906	N24	E37	18	NE SW	11/3/1976	495	NA	NA
21907	N24	E37	18	NW NW	5/4/1979	7,255	NA	7
21910	N24	E37	19	NE SW	10/16/1976	480	NA	NA
66-21	N24	E36	21	NE SE	9/28/1979	9780	NA	13.38
62A-23	N24	E36	23	SW NE	12/11/1993	11,778		20
24W-5	N24	E37	05	SW NW	1/11/1997	1805		16.25
45W-5	N24	E37	05	SW NW	11/1/1985	285	20	5.63

Geothermal Groundwater

Thermal groundwater in Dixie Valley is confined and generally occurs in fracture zones associated with faulting within the basement rock. The geothermal reservoir in the CC lease area is expected at a depth of up to 10,000 feet. Morin et al. (1998) conducted a series of aquifer tests to evaluate the hydraulic characteristics of the geothermal reservoir in Dixie Valley. The tests were conducted on wells penetrating the Stillwater fault at the Dixie Valley Power Plant south of the CC lease area. The transmissivity values (uncorrected for viscosity) ranged from 5 to 67 gpd/ft for wells that did not show enhanced permeability associated with faulting. These values were suggested by Morin et al. to reflect the bulk primary permeability of the basement rock. In the two wells that reflected enhanced secondary permeability related to fault brecciation, the uncorrected transmissivity values ranged from 26,000 to 140,000 gpd/ft. Consequently, localized brecciation associated with faulting can increase the capacity for the basement rocks to transmit water near faults by roughly three to four orders of magnitude. These areas of enhanced permeability appear to be limited in extent; however, thermal gradient measurements indicate that the high thermal gradients in the CC lease area are separated from adjacent areas of high thermal gradients (including that associated with the Dixie Valley Power Plant) suggesting limited lateral hydraulic connection between these areas (Blackwell et al., 2007).

Generally, the deep geothermal reservoir and the shallower alluvial groundwater are separated by a confining sequence thousands of feet thick, composed of shale, siltstone,

volcaniclastic rocks, and a complex of intrusive and extrusive igneous rocks (Bruton et al., 1997). This zone of enhanced permeability in the basement rocks associated with range front faulting may provide a pathway for thermal water to reach the basin-fill rock and sediments. These basin-fill deposits have generally much lower vertical permeability than horizontal permeability. Consequently, deep hot water near the bedrock fault zones has difficulty migrating vertically upward to the surface, and instead may flow laterally for some distance as it works its way upward to where it exits as hot springs. The connection between the deep geothermal reservoirs and hot springs at the surface, therefore, is typically indirect within the Basin and Range Physiographic Province (Blackwell et al., 2003; Smith et al., 2001). However, Kennedy and van Soest (2006) used helium isotope data to evaluate the degree of mixing of thermal and non-thermal groundwater in Dixie Valley. The isotope results identified that features such as fumaroles emanating directly from the Stillwater fault had a helium isotopic content that was indistinguishable from that of the geothermal reservoir, and that all the various wells, springs, and fumaroles tested had evidence of mixing with thermal water based on helium isotope data. The geochemistry of thermal groundwater in the CC lease area is presented in Table 3-6.

TABLE 3-6
Well 66-21 Major Fluid Chemistry

Sample Name	pH (lab)	SiO_2*	Na	K	Li	Ca	Mg	Sr	F	Cl	Br
DV98-104	6.51	325	876	86.9	4.89	40.0	0.35	2.61	3.06	1440	1.05

*Sample filtered acidified
Source: Goff et al. 2002

Specifically for the CC lease area, a significant sequence of impermeable clay in well 66-21 (Figure 3-4) was noted to exist above the geothermal reservoir. The well information indicated that the clay was abundant from about 2,000 to 4,500 feet. This impermeable clay layer was also noted to exist in the SW Lamb #1 (log number 21907) well located within the current TGP producing area (Figure 3-4). Beneath this impermeable clay layer both wells produce high temperature geothermal fluids under high pressures. The existence of this clay layer is significant because it serves as a barrier or "cap" between the deeper geothermal resource and shallow non-thermal groundwater (Mackey Mineral Research Institute, UNR, 1980).

Table 3-7 compares thermal groundwater from the existing Dixie Valley Power Plant with non-thermal groundwater in the basin-fill sediments. Based on generally similar geologic and hydrogeologic conditions, the contrasts indicated in Table 3-7 are anticipated to be similar to those exhibited in the CC lease area. Widespread mixing between groups of water within Dixie Valley (that is, thermal groundwater and non-thermal shallow alluvial groundwater) is not evident (Nimz et al., 1999).

TABLE 3-7
Comparison of Thermal and Non-thermal Groundwater Quality in the Vicinity of the Existing Dixie Valley Power Plant

Ion Pairs	Thermal Water Typical Range	Non-Thermal Water Typical Range
Sodium + Potassium	90 to >95 percent meq/L	20 to 80 percent meq/L
Calcium + Magnesium	<5 to 10 percent meq/L	20 to 80 percent meq/L
Chloride + Sulfate	25 to 90 percent meq/L	25 to 85 percent meq/L
Bicarbonate + Carbonate	5 to 75 percent meq/L	5 to 75 percent meq/L

Notes: Data from interpretation of trilinear diagrams presented by Nimz et al. (1999). Samples collected from wells throughout the Dixie Valley study area.

meq/L = milliequivalents per liter, or milligrams per liter divided by the combining weights of the indicated ions.

As indicated in Table 3-7, the greatest contrast between thermal and non-thermal groundwater involves positively charged ions (cations). The differences in cation concentrations noted in Table 3-7 are useful in evaluating potential effects of the Proposed Action on shallow groundwater quality.

The total dissolved solids (TDS) concentration in shallow alluvial groundwater in Dixie Valley varies over a broad range based on data and modeling completed by Karst (1987). Based on the output of a three-dimensional, two-tier model of Dixie Valley, the upper (non-thermal) tier had a simple, non-weighted average TDS of 1,900 milligrams per liter (mg/L). Thermal groundwater in the area generally has higher dissolved solids content, with an average modeled TDS of 8,800 mg/L (Karst, 1987). However, the geothermal wells at the existing Dixie Valley Power Plant have an average TDS of approximately 2,100 mg/L, with similar water quality expected in the proposed wells, indicating that Karst's modeling overestimated actual TDS values in the geothermal reservoir.

3.11.2.2 Environmental Consequences

Power plant operation involves constructing up to 45 geothermal extraction and injection wells to depths of up to 10,000 feet and operating them in a manner that balances water withdrawals with water injection. The operating design would avoid net consumption of geothermal fluids.

The proposed power generating facility would use either a dry or hybrid cooling system. If dry cooling is used, no water is used in the cooling process; therefore, no impacts would occur to water resources. If hybrid cooling is used, the system would require approximately 550 afy (341 gpm) of water. Under the hybrid cooling system, some evaporation of geothermal fluids would occur as described in Section 2; however, under this scenario, fluids lost via evaporation or other means would be replaced with groundwater from a shallow aquifer water well such that the injection process would replace the same quantity of geothermal fluid as was removed during the production process. Given the lack of groundwater development in and near the CC lease area, no impact to groundwater or users is expected to occur. The Proposed Action includes the construction and development of a water well to provide supplemental makeup water as needed for injection. Water rights for this well will be obtained from existing water rights within the basin.

No impacts to shallow groundwater are expected from pumping and injecting back into the geothermal aquifer. According to available information, the hydraulic connection between the deep thermal aquifer system and the shallow basin-fill aquifer system is poor outside of localized areas adjacent to faulting. Also, the occurrence of an impermeable clay layer separating the geothermal resource from the shallow basin-fill alluvium was identified within the CC lease area. This clay layer provides a significant barrier between shallow non-thermal groundwater and deeper thermal groundwater.

The geothermal extraction and injection wells associated with the power plant would be constructed to maintain the separation between the deep geothermal reservoir and shallow alluvial groundwater. Wells would be subjected to periodic mechanical integrity testing to confirm that they effectively maintain this separation.

Thermal fluids would be transported and handled at the ground surface as part of normal plant operation. As described in Section 3.11.2.1, Affected Environment, thermal groundwater has generally higher dissolved solids than non-thermal groundwater. The saline thermal fluids involved with geothermal development could cause localized groundwater quality effects in the shallow non-thermal aquifer if inadvertently released because of a pipe or valve failure. However, the risk of a significant adverse effect is low because mitigation measures identified in Section 2.1.1.2 would be implemented.

The Proposed Action would have temporary, localized impacts on groundwater during the well testing phase. No other direct or indirect impacts are anticipated except for limited use of alluvial groundwater to replace geothermal water lost to evaporation. Therefore, the Proposed Action would have only temporary contributions to impacts on water resources and water quality, and only a limited effect on water resources (associated with shallow groundwater use).

3.12 Visual Resource Management

3.12.1 Affected Environment

Based on information contained in the CRMP (BLM, 2001), the CC lease area is located within a Class IV VRM area. The objective for this class is to provide for management activities that allow major modifications of the existing character of the landscape. The level of change to the characteristic landscape can be high. Activities in a Class IV category may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic landscape elements.

Sensitive receptors in the CC lease area include people recreating in the area. Recreational activities can include hiking, hunting, sightseeing, nature photography, mountain biking, and off-highway vehicle (OHV) use. The closest transportation route is Dixie Valley Road, which is designated State Route 121 and runs through the Proposed Action area. Current motorized travel in the Dixie Valley area is authorized on existing roads and cross-country travel is prohibited.

The closest urban sensitive receptor (park, church, residence, school, or hospital) is located in Lovelock, Nevada, approximately 32 miles northwest of the Proposed Action area. The Stillwater Range, with peaks higher than 8,500 feet, is located between the Proposed Action area and Lovelock. The closest receptor would be the 7 Devils Ranch located approximately 14 miles northeast of the CC lease area.

3.12.2 Environmental Consequences

During the approximately 2-month drilling process and 3-day well-testing process, the top of the drill rig would be up to 160 feet above the ground surface (depending on the drill rig used). Construction would last approximately 30 months. Drilling and construction would add short-term and temporary line, form, color, and texture contrasts to the existing landscape.

Long-term impacts would include approximately 61 acres of new surface disturbance from the construction of the power plant and approximately 73 acres of disturbance from access roads and well pads being converted from temporary use to permanent use. Additionally, facility structures would be constructed. All newly constructed structures would be below 85 feet.

The Proposed Action would be consistent with the Class IV VRM established for the area. Impacts would be further reduced by implementing the BMPs and mitigation measures identified in Section 2.1.1.3.

The Stillwater Range, with peaks higher than 8,500 feet, is between the CC lease area and Lovelock. The Proposed Action is, therefore, not visible from the Lovelock area and no adverse affects to visual resources are expected.

3.13 Recreation

3.13.1 Affected Environment

The recreational use can be described as "Dispersed Recreation" indicating that at the present time there are no designated trails, campgrounds, or permitted recreational activities that take place within the CC lease area. These lands are open to all individual, commercial, and competitive outdoor recreation uses. In accordance with the CRMP, the BLM-managed lands in the CC lease area is designated as open to OHV use on BLM lands within Dixie Valley. Opportunities for exploring the back-country by vehicle, hunting, camping, sightseeing, and hiking are encouraged (BLM, 2001).

The CC lease area is located within hunting unit 183 (NDOW, 2010b). Big game hunting in this hunting unit consists of desert big horn sheep and mule deer. Desert big horn sheep are predominantly found on the western slopes of the Clan Alpine Mountains at elevations between 3,411 feet and 9,993 feet. Mule deer are predominantly found in mountain ranges at elevations between 4,000 feet and 10,000 feet.

A number of hot springs throughout Dixie Valley are used for recreation; however, most of these springs are not well-defined bathing spots (Trails.com, 2009). There are no recreational springs within the CC lease area.

3.13.2 Environmental Consequences

According to the CRMP, all ROW permit holders must "permit free and unrestricted public access to and upon the right of-way for all lawful and proper purposes, except in areas designated as restricted by the Bureau in order to protect the public safety or facilities constructed on the right-of-way" (BLM, 2001). Thus, access to areas of the project not deemed a public safety hazard shall remain open to recreational users. Plant security features such as perimeter fencing would potentially reduce the amount of area accessible for recreational use by approximately 61 acres. The construction of pipelines connecting the well areas and the power plant area could break up routes for OHV use but because recreation in the area is so dispersed, there would be no adverse impacts from the Proposed Action.

Highway 121 would be used to access the CC lease area and access roads being converted from temporary use to permanent use roads would be consistent with the current vehicle travel designation within the CC lease area. Additionally; project taxes going to Churchill County would be used to improve existing roads.

The presence of the geothermal plant and associated facilities where none previously existed would affect the visual conditions of the area, and cause some impacts to the recreational experience. Given the relatively small footprint of the Proposed Action, impacts to recreation would be minimal. A more detailed discussion of potential visual impacts from the Proposed Action activities is provided in Section 3.14.

3.14 Military Lands

3.14.1 Affected Environment

The Dixie Valley Settlement Area was acquired by the Navy in the 1980s for a supersonic operating area and electronic warfare training range. The U.S. Navy owns 8,480 acres in the Dixie Valley Settlement Area, including 1,440 acres in north Dixie Valley. Just east of the CC lease area, the Navy owns property in Township 24N, Range 36E, in Sections 12 and 13; and Township 24N, Range 37E, in Sections 7, 8, and 18. No components of the Proposed Action would be placed on Navy-owned land. In addition, the Department of Defense operates the Gabbs North Military Operating Area (MOA) designated for low-level supersonic flight operations in the vicinity of the Proposed Action.

3.14.2 Environmental Consequences

The Department of Defense operates the Fallon Range Training Complex, a portion of an MOA designated for low-level supersonic flight operations over the Dixie Valley region. Impacts to the MOA are reviewed by the FAA if the FAA obstruction thresholds are triggered. The Proposed Action would not trigger the FAA obstruction thresholds (14 CFR Part 77.13).

TGP has discussed the Proposed Action with NAS Fallon management. The primary concern expressed by the Navy was the height of electric transmission facilities required for the project. The Navy requested that transmission lines stay below 100 feet in height. In addition, they requested that markings (such as bird flight diverters) be placed on the electric transmission lines. TGP would work with the Navy to select and place markers that meet Navy criteria. Because the proposed lines would be less than 100 feet tall and markers would be placed, there is no unacceptable impact to NAS Fallon activities. A memorandum signed by Commanding Officer R.M. Wilke is included with this document as Appendix C.

3.15 Livestock Grazing

BLM manages rangelands on public lands under 43 CFR Part 4100 and BLM Handbooks 4100 to 4180. BLM conducts grazing management practices in accordance with BLM Manual H-4120-1 (BLM, 1984).

Under this management, ranchers may obtain a grazing permit for an allotment of public land on which a specified number of livestock may graze. An allotment is an area of land designated and managed for livestock grazing. The number of permitted livestock on a particular allotment on public land is determined by how many animal unit months (AUMs) that land would support. An AUM is the amount of forage needed to sustain one mature cow, five sheep, or five goats for 1 month (BLM, 2008a).

3.15.1 Affected Environment

The CC lease area lies within the Boyer Ranch Allotment, which comprises approximately 127,194 acres and 1,789 AUMs of currently authorized grazing capacity. Within this allotment, one AUM is equal to approximately 71 acres.

The grazing allotments within the CC lease area consist entirely of public lands administered by the BLM Carson City District Office. Table 3-8 lists land ownership in the Boyer Ranch Allotment (BLM, 2009a).

TABLE 3-8
Livestock Permit Information—Boyer Ranch Allotment

Permit	Number of Livestock	On Date	Off Date	Animal Unit Months
A	179 cows	5/1	6/30	359
B	179 cows	7/1	9/30	541
C	179 cows	10/1	2/28	889

3.15.2 Environmental Consequences

The Proposed Action would disturb approximately 61 acres. In addition, approximately 73 acres of area disturbed during the exploration phase would be converted to permanent use. The total of 134 acres constitutes less than one percent of the 127,194 acres comprising the Boyer Ranch Allotment, permanently reducing the 1,790 AUMs within the allotment by approximately 1.9 AUMs or less than 0.1 percent. No reduction in authorized grazing use would be required.

3.16 Lands

Most of the land in Dixie Valley is federal land managed by the BLM and nearly all of it is designated as having the highest geothermal resource potential of any BLM-managed public lands in the state (BLM, 2001). The federal government administers more than 82 percent of the land in Churchill County.

Several ROWs or other authorizations have been granted on public lands within the CC lease area. These include ROWs for transmission lines, roads, and geothermal leases. There are 24 BLM-registered geothermal well leases in the vicinity of the CC lease area.

BLM also has prepared a programmatic environmental impact statement (PEIS) for geothermal leasing in the Western U.S. (BLM, 2008c), which analyzes potential impacts of geothermal development and provides a list of stipulations and BMPs related to geothermal leasing and related development on BLM-managed public land. In 2008, BLM issued a Record of Decision for geothermal leasing in the Western U.S., including adoption of Resource Management Plan amendments related to geothermal leasing (BLM, 2008d). In accordance with the BLM PEIS for Geothermal Development (BLM, 2008c) and the Churchill County Master Plan (2010), the expansion and development of geothermal resources is supported and promoted for federal lands in this region in support of a national energy policy for renewable energy.

3.16.1 Affected Environment

The existing Dixie Valley Power Plant is just north of the CC lease area, and a small private ranch is approximately 12 miles northeast of the existing Dixie Valley Power Plant. The area is relatively undeveloped and most of the valley is used for livestock grazing, with BLM assuming grazing management responsibility on adjacent military-controlled lands. Military land ownership and uses are described above in Section 3.16.

Several non-producing geothermal leases and lease agreements are located within the CC lease area (BLM, 2009b).[1] East of the CC lease area is a ROW granted to the Navy by BLM for a remote relay station (ROW grant NVN 043665). Just east of the Proposed Action area is a transmission ROW associated with the existing Dixie Valley 230-kV transmission line (NVN 040324), which runs southwest to northeast through the CC lease area. There are also 100 active unpatented lode mining claims located across the CC lease area (BLM, 2009b).

3.16.2 Environmental Consequences

The Proposed Action would not preempt other current uses of the land identified above.

[1] Based on the BLM Legacy Rehost (LR 2000) Report System and the BLM National Integration Land System GeoCommunicator

3.17 Soils

Soil types in the Proposed Action area were identified using the "Churchill County Area, Parts of Churchill and Lyon Counties" soil survey (U.S. Department of Agriculture National Resource Conservation Service [NRCS], 2009). Descriptions of the soil types found in the CC lease area are provided in this section.

3.17.1 Affected Environment

Figure 3-5 shows soil units delineated by the NRCS within the CC lease area and in the surrounding area. Soil units 184, 330, and 343 are present in the Proposed Action area.

Soil unit 184 is the Bluewing-Pineval association. Bluewing soils occur on 4-8 percent sloping fans or washes, are excessively drained, and flood rarely to occasionally, but never pond. Pineval soils occur on 4-8 percent slopes, are well drained, and rarely flood and never pond.

Soil unit 330 is the Settlement-Louderback-Rustigate association. Settlement soils occur on 0-2 percent slopes, are poorly drained, have a water table depth of 12 to 36 inches, rarely flood and never pond, and are slightly to moderately saline. Louderback soils occur on 0-2 percent slopes, are somewhat poorly drained, have a water table at 36 to 40 inches, rarely flood and never pond, are very slightly or slightly saline, and support saline meadow vegetation. Rustigate soils occur on 0-2 percent slopes, are somewhat poorly drained, have a water table at 36 to 40 inches, rarely flood and never pond, and support a saline meadow vegetation community.

Soil unit 343 is the Slaw-Trocken-Chuckles association. Slaw soils occur on 0–4 percent slopes; are well drained; can occasionally flood, but never pond; and are moderately to strongly saline. Trocken soils occur on 0–2 percent slopes, are well drained, occasionally flood, but never pond, and are moderately to strongly saline. Chuckles soils occur on 0-2 percent slopes, are moderately well drained, never flood or pond, and are moderately to strongly saline.

Soil units 284, 330, and 343 have a slight hazard of off-road or off-trail erosion and are moderately suited for natural surface road construction, primarily due to low strength and sandiness (NRCS, 2009).

3.17.2 Environmental Consequences

The release of hazardous materials to the environment could affect soil resources. BMPs to prevent such a release, including development of a SPCC plan, are described in Section 2.1.1.3.

Erosion and loss of soil productivity would be minimized by implementing the BMPs described in Section 2.1.1.3 during construction.

3.18 Vegetation

Biological surveys, including a vegetation assessment and general wildlife observations, were conducted on June 29, 30, and July 1, 2009 (CH2M HILL, 2009a). An additional assessment of vegetation in portions of the Proposed Action area was conducted August 24 to 27, 2009. Southwest Regional Gap Analysis Project (SWReGAP) landcover data were supplemented and updated with field explorations and reference to *Intermountain Flora, Volume 1* (USGS, 2004; Cronquist et al., 1972).

3.18.1 Affected Environment

Alluvial fan surfaces above 3,430 feet above sea level and below the mountain front support the intermountain basins mixed salt desert scrub community, with the exception of dry wash channels, which contain intermountain basins greasewood flats. The area between 3,430 feet above sea level and the edge of the intermountain basin playa community (approximately 3,390 feet above sea level) is composed of a mosaic of halophytic (salt-tolerant) and hydrophytic (wetland) plant communities. The halophytic communities include intermountain basins greasewood flats, saltgrass (*Distichlis spicata* var. *stricta*) meadows, and iodinebush (*Allenrolfea occidentalis*) scrub. The hydrophytic communities are primarily marshes typified by cattail (*Typha latifolia*), rush (*Juncus* spp. and *Scirpus* spp.), and common reed (*Phragmites australis)*. The playa is largely barren of vegetation.

The intermountain basins mixed salt desert scrub community is characterized by open shrubland dominated by shadscale (*Atriplex confertifolia*) with scattered bush seepweed (*Suaeda moquinii),* yellow rabbitbrush (*Chrysothamnus viscidiflorus*), Nevada jointfir (*Ephedra nevadensis*), spiny hopsage (*Grayia spinosa*), budsage (*Artemisia spinescens*), broom snakeweed (*Gutierrezia sarothrae*), winterfat (*Krascheninnikovia lanata*), Indian ricegrass (*Achnatherum hymenoides*), and cheatgrass (*Bromus tectorum*). Despite its apparent diversity there is much barren ground between the shrubs, and there is little grass cover. Cheesebush (*Hymenoclea salsola*) and desert trumpet (*Eriogonum inflatum* var. *deflatum*) were found occupying disturbed areas during field observations.

The intermountain basins greasewood flats community is dominated by greasewood (*Sarcobatus vermiculatus*) and contains sparsely scattered Torrey's saltbush (*Atriplex torreyi*), yellow rabbitbrush, saltlover (*Halogeton glomeratus*), budsage, and bush seepweed. Bare ground is common and the substrate usually possesses the poorly developed soils of wash-bottoms. Again there are few perennial grasses.

At the fringe of the playa, where the salt concentration appears too great for greasewood, more salt-tolerant communities such as saltgrass meadow and iodinebush scrub are found. Marshes are found at springs, seeps, and around open water in the CC project area. These palustrine emergent wetlands are surrounded by desert vegetation or playa. The marsh vegetation is adapted to saturated soil conditions and includes species of rush, knotweed (*Polygonum* spp.), canarygrass (*Phalaris* spp.), spikerush (*Eleocharis* spp.), duckweed (*Lemna* sp.), as well as common reed and cattail. Riparian trees and shrubs are not common and are restricted to isolated stands of willow (*Salix* sp.), wild rose (*Rosa woodsii*), Russian olive (*Eleaegnus angustifolia*), and saltcedar (*Tamarix ramosissima*), the latter two being introduced species, invasive in many hydric habitats.

The CC project area and the associated access routes are primarily located in intermountain basins mixed salt desert scrub community and salt-tolerant communities (e.g., intermountain basins greasewood flats, saltgrass meadow, and iodinebush scrub). A small part of the CC project area may be located within the intermountain basin playa community, some of which may be in the vicinity of marsh vegetation associated with seeps and springs, based on analysis of aerial photographs and field surveys.

3.18.2 Environmental Consequences

The specific locations of the power plant and 30 additional wells to be installed as part of the Proposed Action would be determined prior to construction. Limited additional impacts would occur as a result of pipeline construction because it would occur along roadways that were approved during exploration. Approximately 134 acres would be disturbed by the Proposed Action; however, a portion of the disturbance would occur on intermountain basins playa, which generally lacks vegetation, therefore, total acres of disturbed vegetation would be less than 134 acres. Disturbance to small areas of wetland vegetation on the fringes of seeps and springs would be minimized by implementation of the project-specific BMPs identified in Section 2.1.1.3.

3.19 Paleontological Resources

3.19.1 Affected Environment

An initial paleontological resources assessment for the Proposed Action area was completed in August 2009 (CH2M HILL, 2009b). In it, the initial Potential Fossil Yield Classifications (PFYC) of the geological units affected by the Proposed Action were determined following the guidance of BLM's Instructional Memorandum No. 2008-009 (BLM, 2007c). Initial PFYC classifications were based on the results of literature searches and record reviews, as well as an analysis of remote imagery of the Proposed Action area. In the Proposed Action area, there are sediments designated as possessing low paleontological sensitivity (PFYC = 2), and those possessing unknown sensitivity but which have yielded scientifically important fossils in other parts of the Great Basin (PFYC = 3b). The latter are sediments that were similar in character and geomorphic setting to those laid down on the margins of Pleistocene (Ice Age) lakes and at ancient springs, both of which are found in the Proposed Action area. Satellite imagery was used to estimate the extent of these sediments, and then these findings were field checked during a paleontological resources survey.

A paleontological survey of the areas with a PFYC of 3b was completed in September 2009 to more specifically characterize their paleontological sensitivity. This field work included surveys of areas with the potential to yield fossil material, in-field determinations of "low" paleontological sensitivity based on (especially) topographic position and nature of the sediments (e.g., alluvium vs. lacustrine silt), and spot-checking areas with a PFYC of 2 to confirm their low paleontological sensitivity.

Fossil material was discovered in only one restricted part of the Proposed Action area. In the case of most of area, however, field evidence justifies a downgrade of areas with an initial PFYC of 3b (unknown) to a PFYC of 2 (low). Areas identified in remote imagery as paleospring deposits based on their albedo and hue were actually found to be salt-encrusted playa surface. Playa sediment normally possesses low paleontological sensitivity near the surface because bone and other organic debris are not only quickly oxidized, but also mechanically degraded by the seasonal dissolution and recrystalization of salts in these soil environments.

The location of remaining areas where sediments possess sensitivity is confidential resource information, and maps showing these areas are documented separately with the BLM.

Alluvium seldom yields fossils, and therefore the alluvial fan sediments that comprise most of the surfaces of Sections 12, 13, 14, 15, 21, and 22 (Township 24N, Range 36E) were given a "low" PFYC of 2. Portions of Sections 13, 14, 15, 21, 22, 23, and 24 that were assigned an initial PFYC of 3b (unknown) were subsequently subject to survey and field review. The subsequent field review and survey established the low paleontological potential (PFYC = 2) of all these areas except portions of Sections 14 and 15.

In portions of Sections 14 and 15 subfossil wood consisting primarily of the logs of pinyon (*Pinus monophylla*) and Utah juniper (*Juniperus osteosperma*) were found on the alluvial fans of two of the larger canyons issuing from the Stillwater Range. Similar wood material was observed outside the Proposed Action area on the surface on the Cottonwood Canyon alluvial fan several miles to the northeast. Woodland currently lies several miles into the

Stillwater Range and more than 1,500 feet higher in elevation. Unlike conventional paleontological material, subfossil wood is simply "mummified" in the dry climate, and its scientific potential lies in its dendrochronological, paleoecological, and surface-age dating potential. Therefore, the portions of Sections 14 and 15 where subfossil wood was found were assigned a PFYC Class 4 (high potential).

3.19.2 Environmental Consequences

Direct impacts on paleontological resources could result from the mechanical destruction of fossils as a consequence of uncontrolled excavations of paleontologically sensitive sedimentary units. This includes grading, and excavating and drilling. Other activities, such as laying roadway gravel over the top of paleontologically sensitive sediment, would have little or no impact on paleontological resources. Indirect effects to paleontological resources could include unauthorized fossil collection after fossil-rich sediment is exposed by excavation, in the absence of measures to restrict public access to such sites or to educate workers on paleontological resource avoidance.

Proposed construction activities that include surface disturbance of the immediate subsurface at the northernmost well pad in Section 15 would have the potential to impact paleontological resources because subfossil wood occurs in the immediate vicinity (PFYC = 4). Prior to construction at this site, this impact would be mitigated by moving the well to the west away from this resource, staking for avoidance that area within Sections 14 and 15 where subfossil wood exists, subsequent avoidance of the area during construction, and by worker education that would include the importance of paleontological resources avoidance. The paleontological potential of the other 24 well pads and their access routes is low (PFYC Class 2); therefore, impacts on paleontological resources are not expected.

Of the 25 well sites in the Proposed Action area, only one possesses high paleontological sensitivity (PFYC Class 4) because of the presence of subfossil wood on the surface in the immediate vicinity. The subsurface potential of all other well pads in the Proposed Action area is considered to be low (PFYC Class 2) because they are located at sites underlain by alluvium or oxidized playa sediments. Impacts on paleontological resources from project development in the area therefore would not occur because the one area designated PFYC Class 4 (high sensitivity) would be avoided by relocation of the well pad and by educating workers on paleontological resources avoidance.

3.20 No Action Alternative

Project features would not be constructed under the No Action Alternative. Therefore, none of the resources described in Section 3 would be affected by the Proposed Action.

3.21 Residual Impacts

Solid waste would be generated as a result of the Proposed Action, resulting in residual impacts. The waste would be disposed in approved, permitted disposal facilities. Impacts to vegetation and soils would be mitigated by the BMPs described in the relevant sections of the analysis above. Impacts to wildlife, including migratory birds and sensitive species, would be limited in nature and mitigated through the use of BMPs described above. The potential introduction of invasive, non-native species as a result of the Proposed Action would be minimized through the use of BMPs. Visual resources would be impacted due to the presence of the plant, ancillary structures, wells, pipelines, substation, and transmission line. However, these visual modifications do not exceed VRM Class IV objectives. Plant security features such as perimeter fencing would potentially reduce the amount of area accessible for recreational use.

Insert Section 3 figures (4 total)