American group that has expressed interest in activities in the area. Both of these tribes have ceremonial, religious, and other special sites in the Medicine Lake Highlands. Other tribes have also occasionally used the area, primarily to obtain obsidian for tool making.

Consultation and Concerns

The American Indian Religious Freedom Act (AIRFA) requires that local Native American groups be consulted regarding any proposed projects that may affect traditional religious practices. In accordance with AIRFA, consultations with local Native American groups are currently being conducted by the USFS, Modoc National Forest, regarding the proposed action. Native American groups have been notified during preliminary planning activities for the proposed action in advance of general public notification. Advance notification of the groups was undertaken to ensure that Native American groups were provided with ample opportunities to express their concerns, and to ensure that their concerns are addressed. Concerned Native American groups were sent a copy of the IP/PAI notice for the project, which summarized the proposed action. No written comments regarding the proposed project were received from Native Americans groups.

Three meetings with Native American groups (one with the Pit River Tribal Council and two with the Klamath Tribes) and one site visit (with the Klamath Tribes) have been conducted by the USFS and BLM. The meeting with representatives of the Pit River Tribal Council was held on October 14, 1994. A full quorum of Council Members was not present. The majority of the comments on the project were presented by a Council member with experience working at The Geysers geothermal field in Northern California (The Geysers is one of only three dry-steam geothermal fields in the world. The Geysers is the largest geothermal field in the United States with over 1800 MW of generating capacity. This type of geothermal resource is not expected at Glass Mountain.). The following concerns about the proposed action were expressed:

- Opposition to development
- Reclamation of well pads after project completion
- Potential fire hazards
- Effects on wildlife
- Number of sites proposed

The Council Members indicated that they would need to discuss the project and that they would like a presentation from the geothermal companies and requested a field trip to Medicine Lake Highlands to view the area. The USFS therefore attempted to set up a site visit with representatives of the tribe, and a site visit planned for early November 1994. However, tribe representatives were not able to attend the visit due to weather conditions.

On April 29, 1994, the USFS sent a request to the Tribal Chairman of the Klamath Tribes group for a meeting to discuss potential geothermal activities at Glass Mountain. A second request was made on June 17, 1994 when no response had been received regarding the first request. As a result of the second request, a meeting with the Klamath Tribes was held on October 18, 1994. A site visit with the tribe to review proposed and existing well

pad sites in the area was then conducted on November 3, 1994, and a second meeting with the tribe was held on February 2, 1995.

During the October 18 meeting with representatives of the Klamath Tribes group, several questions were asked about the proposed project, including:

- Cultural resource studies that have been done
- Objective of the project
- Difference between temperature gradient and exploratory production wells
- Acreage required for a power plant (although not currently proposed)
- Size of pipes
- Reclamation efforts
- Benefits and trade-offs to the Klamath Tribes
- Number of workers
- Other agencies involved (such as Audubon Society and Sierra Club)
- Activities after exploration if a resource is found

The following concerns and issues were expressed by the Klamath Tribes representatives:

- The size of the proposed well pads and drilling holes
- Reclamation of well pads after project completion
- Potential for future geothermal development
- Potential for jobs
- Effect of project on spiritual use of the area
- Visual effects
- Increases in traffic

Concern was also expressed about the consultation process and who would be performing the consultation, and that the consultation be performed prior to a decision being made for the project. The Klamath Tribes group requested copies of the CEGC POO and the Calpine proposal for exploration at Fourmile Hill (see the discussion of cumulative effects in Section 4.12). Representatives of the Klamath Tribes said that Native Americans are uncomfortable with words such as "explore," "discover," and "develop," and these words cause concern to Native Americans because they reflect an exploitation of their resources.

The November 3 site visit with representatives of the Klamath Tribes included visits to the proposed 34-8TCH well pad, as well as the existing sites of well pads 68-8, 17-A6, and temperature gradient hole (TGH) 88-28. Questions were asked about the following topics during the site visit:

- Native American consultation and environmental documentation for existing well pads
- Purposes of various well pad facilities
- Effect from any leaks of drilling fluids contained in sumps
- The monetary benefit to the USFS of geothermal drilling
- Reclamation efforts
- Potential location of a power plant (although not currently proposed)

At the end of the site visit, the representatives of the Klamath Tribes expressed a desire to have more involvement in the consultation process, and requested a copy of the MOU between the USFS and BLM for proposed geothermal activities.

During the February 2 meeting with the Klamath Tribes, representatives of the tribes reiterated the concerns that were expressed at the October 18 meeting. The tribes representatives stressed the spiritual importance of the Medicine Lake area, and stated that they would be opposed to any project that would degrade or harm the area. The USFS inquired into the possibility of implementing restrictions (such as windows of operation or mandatory periods of no activity) to limit the potential effect of the proposed action on Native American uses in the area and to satisfy Native American concerns about the proposed action. The February 2 meeting ended with an understanding that the USFS would provide the Klamath Tribes with project-related information (i.e., site inventories, photographs, and an internal draft copy of the EA/IS), as well as other activities in the area (including geothermal) that the USFS has already permitted or is currently analyzing.

The USFS is continuing to solicit specific concerns from Native Americans, although no written comments have been received to date. Native Americans have expressed the desire to conduct consultations in person, rather than just through letters.

3.5 Biology

REGULATORY FRAMEWORK

The Federal Endangered Species Act (FESA) and the California Endangered Species Act (CESA) provide the general framework for the protection of endangered and threatened plant and animal species. An "endangered" species is defined as any species that is in danger of extinction throughout all or a significant portion of its range. This protection also extends to those species proposed for listing as threatened or endangered and those that are candidates for listing.

VEGETATION

The vicinity of the proposed action is a diverse area of moderately sloping to steep mountains, sinks, expanses of lava flows, and forested and logged lands. Elevation in the immediate vicinity of the proposed action ranges from approximately 6,200 feet above sea level near 63-20TCH to about 7,800 feet at Mount Hoffman and Red Shale Butte. Considerable structural diversity occurs in the region and is a result of past disturbances (primarily logging activities and fires) and site-specific conditions.

Special Status Species

No special status plant species have been identified or are known to occur at any of the proposed well pad sites or access road corridors. There are two special status plant species that have been located in the Medicine Lake Highlands: talus collomia (*Collomia larsenii*) and northern daisy (*Trimorpha acris* var. *debilis*) (Sanger 1995). The talus collomia grows on loose volcanic gravel; this type of habitat is not present at any of the well pad sites or

access road corridors. The northern daisy grows in lava outcrops in subalpine forests. The only known occurrence of this species is within Alcohol Crater (see Figure 1.1-2). Suitable habitat for the northern daisy is not present at any of the well pad sites or access road corridors (Wildlife Dynamics 1994).

General Vegetation

Two main forest types are found in the vicinity of the proposed action: lodgepole pine (*Pinus contorta*) and red fir (*Abies magnifica*). Dominant tree species include lodgepole pine, red fir, ponderosa pine (*Pinus ponderosa*), and white fir (*Abies concolora*). Understory is generally quite sparse, but occasional significant quantities of manzanita (*Arctostaphylos patula*) are present.

Most forest habitats in the vicinity have been harvested in the past, with only small pockets of "old growth" or unharvested timber stands remaining scattered throughout the vicinity of the proposed action. With the exception of well pad 46-32, all wells would be at least partially located on old log landings, logging roads, or in previously clear-cut areas that do not contain unharvested timber stands. Both even-aged and uneven-aged forest management practices have been conducted in the vicinity.

Table 3.5-1 provides a summary of vegetation at each of the TCH and exploratory well pad sites. Lodgepole pine and/or red fir dominate all of the well pad sites. In addition to these species, the most common tree species found at the well pad sites are white fir, ponderosa pine, and western white pine (*Pinus monticola*). Mountain hemlock (*Tsuga mertensiana*) can be found at the site of well 46-32.

Table 3.5-1 also provides an identification of habitat suitability for wildlife at each of the well pads. Wildlife habitat suitability is discussed in detail later in this section.

The proposed well pad sites and access road corridors are generally not located in timber stands that could be considered pure old growth forest. However, some old growth trees do exist on the sites of proposed wells 46-32 and 18-32, as well as in the access road corridor to the site of well 46-32; these proposed facilities are located in a previously unharvested area. In addition, there are old growth trees located on portions of well sites 58-6 and 56-18, which are in areas that have been subject to previous timber harvest.

General habitat components such as canopy closure, tree diameter at breast height (dbh), and snag densities differ at each well site (see Table 3.5-1). A brief description of vegetation at each of the proposed well sites and associated access road corridors follows.

34-8TCH

The site for well pad 34-8TCH is located entirely in a lodgepole pine regeneration stand on a previous log landing. Trees are from 6 to 15 feet tall and very dense. A logging debris pile forms the dead and downed (d/d) component at this pad. The access road to the well pad is an existing spur road that has been overgrown with lodgepole pine seedlings and saplings.

Table 3.5-1: Vegetation and Wildlife Habitat Suitability at Well Pad Sites[1]

Well Pad	Vegetation	Wildlife[2]
34-8TCH	Dominant species: lodgepole pine Canopy closure: 85% dbh[3]: 1 to 4 inches Snag density: 0 Previously cleared?: yes	American marten: MF[4] Mule deer: GHC
42-13TCH	Dominant species: lodgepole pine Canopy closure: 30% dbh: 3 to 8 inches Snag density: 1 per acre Previously cleared?: yes	Northern goshawk: SF Woodpeckers: MF[4] American marten: MF[4] Mule deer: SF
11-24TCH	Dominant species: lodgepole pine, red fir Canopy closure: 70% dbh: seed/sapling Snag density: 0 Previously cleared?: yes	American marten: MF[4] Mule deer: SF
15-15TCH	Dominant species: herbaceous vegetation Canopy closure: 0% dbh: n/a Snag density: 0 Previously cleared?: yes	American marten: MF[4]
63-20TCH	Dominant species: herbaceous vegetation Canopy closure: 0% dbh: n/a Snag density: 0 Previously cleared?: yes	American marten: MF[4] Mule deer: SF
18-32	Dominant species: lodgepole pine (center); lodgepole pine, red fir, western white pine (edges) Canopy closure: 50% (center); 65% (edges) dbh: seed/sapling (center); 1 to 40 inches (edges) Snag density: 0 (center); 4 per acre (edges) Previously cleared?: partially	Northern spotted owl: SF, MR[4] Northern goshawk: SF, SR Pileated woodpecker: SF, SR Woodpeckers: SF, SR American marten: SF, SR Mule deer: STC
46-32	Dominant species: lodgepole pine, red fir, western white pine, mountain hemlock Canopy closure: 55% (varies from 30% to 70%) dbh: 4 to 36 inches Snag density: 4 per acre Previously cleared?: no	Northern spotted owl: SF, MR[4] Northern goshawk: SF, SR Pileated woodpecker: SF, MR[4] Woodpeckers: SF, SR American marten: SF, SR Mule deer: STC
58-6	Dominant species: lodgepole pine Canopy closure: 35% dbh: seed/sapling to 18 inches Snag density: 0.5 per acre Previously cleared?: partially	Northern goshawk: MF, MR[4] American marten: MF[4] Mule deer: MTC[4]

Table 3.5-1: Vegetation and Wildlife Habitat Suitability at Well Pad Sites (continued)

56-18	Dominant species: lodgepole pine, red fir Canopy closure: 40% (highly variable) dbh: 1 to 32 inches Snag density: 2 per acre Previously cleared?: partially	Northern goshawk: SF Pileated woodpecker: SF Woodpeckers: SF, SR American marten: SF
13-18	Dominant species: lodgepole pine Canopy closure: 5% (center); 65% (edges) dbh: seed/sapling (center); 1 to 24 inches (edges) Snag density: 0 (center); 0.2 per acre (edges) Previously cleared?: partially	Northern goshawk: SF, SR American marten: SF Mule deer: STC, MF[4]

Notes:

[1]Includes proposed access road corridors where appropriate.

[2]Key to abbreviations: MF = marginally suitable for foraging; SF = suitable for foraging; MR = marginally suitable for reproduction; SR = suitable for reproduction; GHC = good hiding cover; MTC = marginally suitable for thermal cover; STC = suitable for thermal cover.

[3]dbh = diameter at breast height.

[4]Certain well pads contain habitat that is marginally suitable for a particular species; that is, the habitat contains at least two important habitat requirements for a species, but does not meet all of the minimum requirements to qualify as suitable habitat for the species. Well pads that contain marginally suitable habitat are identified in this table and are discussed in detail in the wildlife section.

SOURCE: Wildlife Dynamics 1994

42-13TCH

The site for well pad 42-13TCH is located entirely in an open, previously thinned, lodgepole pine stand. A scattered seedling and sapling layer of lodgepole pine is also present in the stand. Although snags tend to be less than 10-inch dbh, one 10-inch dbh snag is present in the pad site. D/d logs are common (approximately 20 per acre), but most are in an advanced decay stage. The majority of the proposed 1,500-foot access road (approximately 1,100 feet) to the well pad site would be located on an old spur road that has some regeneration lodgepole pine seedlings and saplings growing in it. The remaining 400 feet of the access road does not follow an existing road, but passes through a young, open stand of lodgepole pine with scattered red fir. Most trees in this area have a dbh of from 3 to 8 inches.

11-24TCH

The site for well pad 11-24TCH is located on an old log landing that is overgrown with red fir and lodgepole pine seedlings and saplings. The proposed access road to the well pad site is an existing spur road that has been overgrown with lodgepole pine and red fir seedlings and saplings.

15-15TCH

The site for well pad 15-15TCH is located on an old log landing and natural opening that is dominated by herbaceous vegetation. The pad site has one log debris pile. The proposed access road to the well pad site is an existing spur road that goes through the center of the well pad site.

63-20TCH

The site for well pad 63-20TCH is located on an old log landing that is dominated by herbaceous vegetation. The pad site has one log debris pile. The proposed access road to the well pad site is an existing spur road that goes through the center of the well pad site.

18-32

The site for well pad 18-32 is located partially on an existing temperature core hole well pad (28-32) and partially on an existing spur road. The existing pad measures approximately 100 feet by 200 feet and is overgrown with lodgepole pine seedlings and saplings. The existing spur road contains no vegetation. No d/d logs are found at the existing pad or in the road.

The remaining portion of the site for well pad 18-32 is a mature, multi-layered, forest dominated by lodgepole pine with red fir and very scattered western white pine. The forest in this area has not been previously harvested and contains old growth trees. Snags have a dbh of from 8 to 38 inches. D/d logs are common and vary in densities. Overall d/d densities are approximately 20 per acre.

46-32

The site for well pad 46-32 is located in a forested area that has not been previously harvested. The site is a mature, two-layered, lodgepole pine forest with scattered red fir, white pine, and mountain hemlock that contains old growth trees. Snags have a dbh of from 8 to 25 inches. D/d logs are common (approximately 20 per acre), but most are less than 14 inches in diameter and are in a state of advanced decay.

The proposed access road corridor to the well pad site also passes through a forested area that has not been previously harvested. The corridor connects the site well pad 46-32 to the existing USFS spur road that accesses the existing well pad 28-32 (and that accesses the site of proposed well pad 18-32). Vegetation within the access road corridor is generally the same as the vegetation at well pad 46-32.

58-6

The site of well pad 58-6 contains a mature lodgepole pine forest that has been commercially thinned at least once. Scattered larger trees at the site could be considered old growth. Snags appear to have been mostly felled in the area. D/d logs are common (approximately 25 per acre), but most are less than 14 inches in diameter. The proposed access road to the well pad site is an existing skid road that connects to an existing USFS spur road. Trees along the edges of the skid road are predominantly lodgepole pine.

56-18

The site of well pad 56-18 is centered on an area that has been subject to previous timber harvest activities that have removed many of the larger overstory trees. The area is a multi-layered, open canopy, forest dominated by red fir and lodgepole pine. The edges of the pad site have not been harvested as heavily as the center of the pad site. The trees at the edges therefore tend to be slightly larger in size and have a more closed canopy; some of these trees could be considered old growth. Snags have a dbh of from 8 to 25 inches. Scattered logging debris is the primarily d/d component. D/d densities are approximately 15 per acre. There are many old skid roads located throughout the site.

The proposed access road to the well pad site is an existing skid road with some regenerative lodgepole pine that connects to an existing paved County road. The route of the proposed access road passes through habitat similar to the center of the well pad site.

13-18

The site of well pad 13-18 is located in an existing clear-cut area that has been unsuccessfully replanted. This area has sparse lodgepole pine seedlings and saplings and covers approximately 70 percent of the proposed well pad site. The d/d component in the clear-cut area is primarily logging debris and debris piles, and d/d densities are approximately 15 per acre. D/d logs are generally less than 10 inches in diameter.

The remainder of the site of well pad 13-18 (on the north and south edges of the pad site) contains mature lodgepole pine that has been thinned by previous timber harvest activities. Herbaceous and shrub layers are lacking throughout this area. D/d logs densities are approximately 15 per acre. However, these d/d logs are mostly in an advanced state of decay and are generally less than 15 inches in diameter.

WILDLIFE

In order to identify the potential for wildlife species in the vicinity of the proposed action, a habitat assessment of the proposed well pads and access road corridors for wildlife species was conducted in September 1994 by Wildlife Dynamics (Wildlife Dynamics 1994). This habitat assessment supplemented wildlife surveys that have been conducted in the vicinity of the proposed action in the past (Gutiérrez 1993; Galea 1994). Protocols for habitat surveys were reviewed with USFS personnel to ensure acceptable data collection methods. In addition, the USFS has been consulted and a literature review was performed to identify specific animal species of concern. The following summarizes the results of these efforts.

Species of Concern

The Modoc National Forest provides habitat for more than 350 species of wildlife. Of these species, the USFS has listed a total of 37 species as Management Indicator Species (MIS) (see Table 3.5-2). These species require special management practices in order to ensure their viability. A description of the habitat requirements and management practices for

Table 3.5-2: Management Indicator Species in the Modoc National Forest

Species	Common Name	Scientific Name
Birds	Northern spotted owl[1]	*Strix occidentalis caurina*
	Northern goshawk[1]	*Accipiter gentilis*
	Hairy woodpecker	*Picoides villosus*
	Pileated woodpecker[1]	*Dryocupus pileatus*
	Bald eagle[1]	*Haliaeetus leucocephalus*
	Golden eagle	*Aquila chrysaetos*
	Willow flycatcher[1]	*Empidonax trailii*
	Canada goose	*Branta canadensis*
	Mallard	*Anas platyrhynchos*
	Swainson's hawk	*Buteo swainsoni*
	Osprey	*Pandion haliaetus*
	Prairie falcon	*Falco mexicanus*
	Peregrine falcon	*Falco peregrinus*
	Blue grouse	*Dendragapus obscurus*
	Sage grouse	*Centrocercus urophasianus*
	Sandhill crane	*Crus canadensis*
	Red-breasted sapsucker	*Sphyrapicus ruber*
	Red-naped sapsucker	*Sphyrapicus nuchalis*
	Yellow warbler	*Dendroica patechia*
Mammals[2]	American marten[1]	*Martes americana*
	Mule deer[1]	*Odocoileus hemionus*
	Western gray squirrel	*Scriurus griseus*
	California bighorn sheep	*Ovis canadensis*
	Pronghorn	*Antilocapra americana*
	Small-footed Myotis bat[1]	*Myotis subulatus*
	Long-eared Myotis bat[1]	*Myotis ebotis*
	Long-legged Myotis bat[1]	*Myotis volans*
	Fringe Myotis bat[1]	*Myotis thysanodes*
	Yuma Matis bat[1]	*Matis*
Fish	Modoc sucker	
	Lost River sucker	*Deltistes luxatus*
	Shortnose sucker	*Chasmistes brevirostes*
	Goose Lake redband trout	*Onchorhynchus mykiss*
	Rainbow trout	*Onchorhynchus mykiss*
	Brook trout	*Salvelinus fontinalis*
	Brown trout	*Salmo trutta*
	Largemouth bass	*Micropterus salmoides*

Notes:

[1]These Management Indicator Species (MIS) have been identified by the USFS as species that could occur in the vicinity of the proposed action and be affected by the proposed action.

[2]Although not identified as a mammal MIS, the USFS has expressed management concern over the Pacific western big-eared bat, which could occur in the vicinity of the proposed action.

SOURCE: USFS 1991a; Wildlife Dynamics 1994

each of the MIS is provided in the USFS's *Modoc National Forest Land and Resource Management Plan* (USFS 1991a). Consultations with the USFS identified the following 12 MIS with the potential to occur in the vicinity of the proposed action that could potentially be affected by the proposed action (Ratcliff 1993-1995; Sharp 1993-1995):

- Northern spotted owl
- Northern goshawk
- Pileated woodpecker
- Bald eagle
- Willow flycatcher
- American marten
- Mule deer
- Small-footed, Long-eared, Long-legged, and Fringe Myotis bats
- Yuma Matist bat

Although other MIS are not considered to occur in the immediate vicinity of the proposed action, habitat suitability for all MIS was considered during the habitat assessment of the proposed well pads and access roads. The USFS required that the suitability of reproductive and foraging habitat for species of concern be determined by ground truthing and aerial photograph interpretation. Criteria for establishing habitat suitability was provided by the USFS (Villegas 1994) and through a review of current literature and the *Modoc National Forest Land and Resource Management Plan* (USFS 1991a).

In addition to the 12 MIS, the USFS expressed management concern over all woodpecker species (specifically regarding reductions in snag density levels) and the Pacific western big-eared bat (Ratcliff 1994). A discussion of the species with the potential to occur in the vicinity of the proposed action follows.

Northern Spotted Owl: The northern spotted owl is designated as a state endangered and a federal threatened species. The project area is located on the extreme eastern edge of the range of the northern spotted owl, which includes areas in western Washington and Oregon, as well as northwestern California (USFS and BLM 1994a). The owl forages primarily in areas that have stands of mature conifers (i.e., old growth forests) possessing a canopy closure greater than 40 percent, with dominant trees having a mean diameter at breast height (dbh) of 11 to 22 inches. The owl also prefers mature conifer stands for reproductive habitat. Other reproductive habitat requirements for the northern spotted owl include a canopy closure greater than 40 percent and a dominant tree mean dbh of greater than 22 inches.

Northern Goshawk: The northern goshawk is considered to be a California Species of Special Concern. The goshawk is difficult to detect, and is not tolerant of human activity. This species prefers to forage in wooded areas (particularly mature and old-growth stands of conifer and deciduous habitats) interspersed with meadows and other openings. The species uses snags and dead-topped trees for observation and prey-plucking perches. The goshawk usually nests near water and uses a mix of any tree species (including pure lodgepole) with a canopy closure greater than 50 percent as nesting habitat. At least some

of trees must have a dbh greater than 12 inches and be at least 40 feet tall to serve as potential nest trees.

Pileated Woodpecker: The pileated woodpecker prefers mostly mature stands of mixed conifer with a canopy closure greater than 50 percent as reproductive habitat. Pileated woodpeckers also requires snags with a dbh of 10 to 24 inches at a density of at least 1.5 snag per acre, as well as snags with a dbh greater than 24 inches at a density of at least 0.25 snags per acre.

Woodpecker (other): Most woodpecker species are dependent on snags for foraging and/or reproductive habitat. Snags with a dbh greater than six inches at a density of at least two snags per acre is considered to be suitable habitat for woodpecker species.

Bald Eagle: The bald eagle is a state and federal endangered species. This species typically forages on large water bodies or free-flowing rivers with abundant fish populations and with adjacent snags or other perches. In winter months, carrion and waterfowl become important food items, particularly in the Klamath Basin. This species prefers to nest within one mile of a permanent water source. The bald eagle generally nests in large old-growth tree stands with less than 40 percent canopy closure. Nests are usually located 50 to 200 feet above ground.

Within the vicinity of the proposed action, densities of bald eagles are considered to be low. The area encompassing Medicine Lake and Medicine Mountain has been designated as a bald eagle management area (BEMA). A nesting eagle pair has been identified in this area. In addition, winter roost areas for the bald eagle are located five to 10 miles north of the proposed action. Roosting has also been documented to the west of Mount Hoffman, which is located north of the proposed action.

Willow Flycatcher: The willow flycatcher uses deciduous tree and shrub thickets associated with riparian and meadow habitat types. The distribution of this species on the Modoc National Forest is unknown, but it is thought to occur in willow stands associated with meadows throughout the Forest. Sightings have occurred in the South Warner Mountains and the Modoc National Wildlife Refuge, both over 25 miles to the east of the proposed action.

American Marten: The American marten is designated as a California Species of Special Concern that was once trapped for its valuable fur. This species is considered to be an uncommon species that frequents semi-secluded forest tracts, and is difficult to detect. The marten prefers mostly mature stands of mixed conifer in semi-arid areas with the presence of some large diameter snags, as well as stumps and logs near meadows and riparian areas. The marten requires an abundant downed-log component in its reproductive habitat, preferably of relatively large diameter and with root wads. Red fir and lodgepole pine are considered to be suitable habitat for the species.

Mule Deer: Mule deer in the vicinity of the proposed action are considered to be a part of the Glass Mountain deer herd. The vicinity of the proposed action is in the summer range

of the deer due to its high elevation. Deer require an interspersion of thermal cover (mature tree canopy) and forage areas (open canopy forest, openings, or early successional communities) throughout the year. This type of interspersion is typical in the vicinity of the proposed action. Habitat quality for mule deer is considered to be decreased in areas where road densities are greater than 1.5 miles of open roads per square mile and where forest practices have reduced or eliminated preferred browse plant species.

Bats: The Pacific western big-eared bat is considered to be a California Species of Special Concern, and the small-footed, long-eared, long-legged, and fringe Myotis bats and Yuma Matist bat are MIS. These species prefer caves that have "full-dark" zones and air ventilation. The Myotis and Yuma Matist bats also use large Shasta red fir, Ponderosa pine, or similar type tree snags with thick, loose, and flaky bark as habitat. Evidence of bat habitation is usually indicated by droppings and food remnants such as insect parts.

Wildlife Survey Results

Table 3.5-1 summarizes the results of the wildlife habitat assessment for the proposed action by well site. For each of the proposed well sites, the specific wildlife species that could use the well pad site as habitat are identified, and the quality and type of habitat that is present at the well pad site for the species is noted. The following is a discussion by wildlife species of the suitability of the well sites as habitat for each species that has been identified as a species of concern for the proposed action by the USFS.

Northern Spotted Owl: Proposed well pads 18-32 and 46-32 provide suitable foraging habitat and marginally suitable reproductive habitat for the northern spotted owl. Although well pad 18-32 does not meet all of the owl reproductive habitat requirements, the well pad is considered to be marginal reproductive habitat since trees and snags greater than 22 inches dbh are present (but not dominant) and since the canopy closure is greater than 40%. Well pad 46-32 has similar characteristics as pad 18-32, and is located in an unharvested, unroaded mature conifer forest; well pad 46-32 is therefore designated as marginal reproductive habitat although it does not meet all of the owl reproductive habitat requirements.

Northern spotted owl surveys in accordance with U.S. Fish and Wildlife Service (USFWS) protocol were conducted in the project vicinity in 1992 and 1994 (Gutiérrez 1993; Galea 1994). These surveys included all of the proposed well pad and access road locations except for pad sites 63-20TCH and 15-15TCH (see Figure 1.1-2). One spotted owl detection was made during the 1992 survey. Follow-up callings did not receive a response, and the detected owl was therefore determined to just be passing through the vicinity. The 1992 survey indicated that there are no resident owls in the project vicinity, and that the project vicinity is not within any owl home ranges (Gutiérrez 1993). No owls were detected during the 1994 survey, which confirmed the conclusion of the 1992 surveys that there are no resident owls in the project vicinity and that the project vicinity is not within any owl home ranges (Galea 1994).

Northern Goshawk: All of the exploration well pad sites and one of the TCH well pad sites provide habitat for this species. Suitable foraging habitat can be found at the site of 42-13TCH and at all of the exploration well pad sites except for 58-6. Exploration well pads 18-32, 46-32, and 13-18 provide suitable reproductive habitat for the goshawk.

Marginally suitable foraging and reproductive habitat for the northern goshawk can be found at the site of well pad 58-6. Although this well pad does not meet all of the goshawk habitat requirements (particularly the requirement for a minimum of 50% canopy closure), the well pad is considered to be marginal habitat since dominant trees at the pad are greater than 12 inches dbh.

The 1994 survey for spotted owl also included a survey for the northern goshawk in accordance with USFS protocol (Galea 1994). As noted above, this survey included all of the proposed well pad and access road locations except for pad sites 63-20TCH and 15-15TCH. Three goshawk detection were made during the 1994 survey. Since follow-up callings did not receive a response and goshawk nests were not found in the vicinity, the detected goshawks were determined to just be passing through the vicinity (Galea 1994).

Pileated Woodpecker: Habitat for the pileated woodpecker can be found at well pad sites 18-32, 46-32, and 56-18. All three of these well pad sites provide suitable foraging habitat for this species. The site of well pad 18-32 contains suitable reproductive habitat, while the site of well pad 46-32 provides marginally suitable reproductive habitat. Well pad 46-32 is considered to be marginal habitat since the densities of large-diameter snags is below the minimum requirements, but this habitat component is present on the pad and in surrounding habitats.

Woodpecker (other): Similar to the pileated woodpecker, habitat for other woodpecker species can be found at well pad sites 18-32, 46-32, and 56-18. All three of these proposed well pads provide suitable foraging and reproductive habitat for woodpeckers. In addition, the site of 42-13TCH provides marginally suitable foraging habitat for woodpeckers. This TCH well pad is considered to be marginal habitat since snags are present at the pad, but at densities below the minimum requirement of two snags per acre.

Bald Eagle: The bald eagle was not observed in the vicinity of the proposed action, and the proposed well pad sites and associated access road corridors generally do not provide habitat that is considered suitable for the species. There are no known bald eagle nesting or foraging areas in the immediate vicinity of the proposed well pad sites or access road corridors (Ratcliff 1993-1994).

Well pad site 11-24TCH is located just within the southeastern corner of the BEMA, and site 15-15TCH is located to the west of the western boundary of the BEMA. However, the nesting eagle pair identified in the BEMA is not known to use the habitats in the vicinity of these proposed well pad sites (Ratcliff 1993-1994). In addition, these well pad sites are not considered to be suitable habitat for the species.

Willow Flycatcher: The willow flycatcher was not observed in the vicinity of the proposed action, and suitable habitat does not exist at the proposed well pad sites or access road corridors.

American Marten: All of the proposed well pad sites provide some form of habitat for the American marten. Suitable foraging habitat can be found at all of the exploration well pad sites except for 58-6. Well pad sites 18-32 and 46-32 provide suitable reproductive habitat for the marten.

Marginally suitable foraging habitat for the American marten can be found at the site of well pad 58-6 and at all of the TCH well pad sites. Well pad 58-6 is designated as marginal foraging habitat since the pad contains large debris piles and some rock crevices that could be used by marten for denning, but the pad has a variable canopy cover and evidence of past human disturbance. The TCH well pad sites are considered to be marginal foraging habitat since the pad sites contain debris piles and/or a conifer canopy, but do not meet all of the marten foraging habitat requirements.

Mule Deer: All of the proposed well pad sites are within the summer range of the mule deer. Since mule deer are generalist species (in terms of habitat), most of the proposed well pad sites provide at least marginal cover or foraging habitat. The site of 34-8TCH could provide good hiding cover for mule deer. Well pad sites 18-32, 46-32, and 13-18 provide suitable thermal cover. Well pad sites 42-13TCH, 11-24TCH, and 63-20TCH contain suitable foraging habitat for mule deer.

The site of well pad 58-6 provides marginally suitable thermal cover, and the site of well pad 13-18 provides marginally suitable foraging habitat. Well pad 58-6 is considered to provide marginal thermal cover since the pad meets some of the requirements for thermal cover for the mule deer, but has a slightly deficient and variable canopy cover. Well pad 13-18 is designated as marginal foraging habitat since the pad contains only a limited diversity of browse plant species for deer foraging.

Bats: Bat species were not observed in the vicinity of the proposed action, and no suitable caves was found at the proposed well pad sites or access road corridors for these species. Habitat requirements for the Myotis and Yuma Matist bats (i.e., large snags with thick, loose, and flaky bark) were not specifically surveyed for during the habitat assessment. However, based on the vegetation at each of the well pads (see Table 3.5-1), there is the potential for this habitat at only three of the well pads: 18-32, 46-32, and 56-18.

3.6 Air Quality

METEOROLOGY

The climate of the project region is temperate and semiarid, characterized by relatively hot and dry summers and cool and moist winters and springs. Climatic conditions vary considerably in the region, depending primarily on elevation. Recorded temperatures in the project vicinity have ranged from -8°F in the winter to 101°F in the summer. The

average annual precipitation in the vicinity of the proposed action is about 43 inches per year, but ranges from about 35 to more than 45 inches per year. Much of the precipitation occurs as snowfall that infiltrates into the subsurface as it melts.

Winds in the vicinity of the proposed action are highly variable and are affected by regional wind patterns and topography. Mount Shasta, located approximately 40 miles southwest of the proposed action, influences weather patterns over the entire region. Gusty winds of high velocity can occur in the region, with storm gusts occasionally exceeding 60 miles per hour (mph). Winter snowstorms generally bring winds blowing from the southwest or northwest. In the Lava Beds National Monument to the north of the proposed action, dry winds from the northwest prevail. The vicinity of the proposed action is subject to severe thunderstorms during the late spring months and the summer months, with storms building up over the cooler Medicine Lake Highlands.

REGULATORY FRAMEWORK

Federal, state, and local requirements and standards provide regulation of air quality in the vicinity of the proposed action.

Federal

The Federal Clean Air Act (CAA) required the U.S. Environmental Protection Agency (EPA) to identify ambient air quality standards (AAQS) to protect public health and welfare. Federal AAQS have been set for the following pollutants: total suspended particulate (particulate matter less than 10 microns [PM_{10}]), carbon monoxide (CO), oxides of nitrogen (NO_x), ozone (O_3), sulfur dioxide (SO_2), and lead (Pb). These pollutants are called "criteria" pollutants because the standards satisfy criteria specified in the CAA. Federal AAQS are identified in Table 3.6-1.

Pursuant to the CAA, the EPA has classified air basins (i.e., distinct geographic regions) as either "attainment" or "non-attainment" for each criteria pollutant, based on whether or not the Federal AAQS have been achieved. Air basins that have not received sufficient analysis for certain criteria air pollutants are designated as "unclassified" for those pollutants. The EPA has designated Siskiyou County as unclassified for all criteria pollutants.

In addition to the Federal AAQS, the CAA has also designated areas within the United States as either Class I or Class II air quality areas. Class I areas are national parks and wilderness areas of a given size that were in existence prior to 1977 or have since been redesignated (40 CFR 52.21). Class I is the most stringent air quality category and was assigned by Congress to prevent further deterioration of air quality in these areas. Class II areas are all of the remaining areas outside of the Class I area boundaries.

In the vicinity of the proposed action, there are two wilderness areas totaling 28,460 acres that are designated as Class I areas. Both of these wilderness areas are located in the Lava Beds National Monument and are designated as the Lava Beds National Wilderness Area. The remainder of the vicinity of the proposed action is designated as Class II areas.

Table 3.6-1: State and Federal Ambient Air Quality Standards

Pollutant	Averaging Period	California Standards ($\mu g/m^3$)[1]	Federal Standards ($\mu g/m^3$)
PM_{10}	24-Hour	50	150
	Annual	30	50
NO_x (as NO_2)	1-Hour	470	–
	Annual	–	100
SO_2	1-Hour	655	–
	3-Hour	–	1300
	24-Hour	105	365
	Annual	–	80
CO	1-Hour	23,000	40,250
	8-Hour	10,350	10,350
O_3	1-Hour	180	235
Pb	30-Day	1.5	–
	Quarterly	–	1.5
H_2S	1-Hour	42	–

Notes:
[1] $\mu g/m^3$ = micrograms per cubic meter

SOURCE: California Air Resources Board 1991

State and Local

The California Air Resources Board (CARB) is the state agency responsible for regulating mobile source (vehicle) emissions and overseeing the activities of local air pollution control districts (APCDs). In addition, CARB has established state AAQS (see Table 3.6-1). The state AAQS are generally more stringent than the Federal AAQS. Under the California Clean Air Act (which was patterned after the Federal CAA), areas have been designated as attainment, non-attainment, or unclassified with respect to state ambient air quality standards. Siskiyou County is considered unclassified for the state AAQS for all criteria pollutants (CARB 1992).

The Siskiyou County Air Pollution Control District (SCAPCD) is responsible for local regulation of air quality. New sources of air pollutants must acquire an Authority to Construct (ATC) and a Permit to Operate (PTO) from the SCAPCD.

EXISTING AIR QUALITY

The air in the vicinity of the proposed action is considered to be of excellent quality. There are very few significant pollutant sources in the vicinity of the proposed action, and background concentrations of criteria air pollutants are considered to be low. Of the criteria air pollutants, particulate matter is of the greatest concern, primarily in the summer months. During these months, wildfires, controlled burns for forest management and logging, and agricultural burning are the principal activities in the vicinity of the proposed action that generate airborne fugitive dust. Mineral extraction operations and

agricultural activities in the vicinity also occasionally contribute to particulate matter emissions in the region during the summer.

3.7 Noise

REGULATORY FRAMEWORK

The Federal GROs (no. 4) define limits for noise from geothermal activities. Noise levels must be 65 dBA or less at the lease boundary or 0.5 miles from the source, whichever is greater.

NOISE LEVELS

In general, ambient noise levels in the vicinity of the proposed action are low and typical of rural and open space areas. Natural noise sources include animals, wind, and occasional summer thunderstorms.

No major man-made sources of constant noise (such as industrial facilities) currently exist in the vicinity of the proposed action. The most significant existing sources of noise are machinery and vehicles. The use of machinery for logging and mining operations results in occasional audible noise in portions of the vicinity of the proposed action. Noise from the use of recreational vehicles (such as motorcycles and snowmobiles) in the area is also occasionally audible.

Ambient noise levels include intermittent noise from previously authorized geothermal activities.

3.8 Visual Resources

The vicinity of the proposed action is characterized by a diversity of distinct land forms and vegetation that is relatively undisturbed by man-made features. The volcanic history of the area has resulted in dramatic geologic features such as volcanic rims, cinder cones, collapsed lava tubes, lava flows, and volcanic craters. The topography in the vicinity of the proposed action is extremely varied, which provides vista and vantage points throughout the region. Although logging activities have occurred in the vicinity of the proposed action, the area remains heavily forested. The combination of these features provides the unique scenic qualities of the area.

The primary influence of humans on the visual landscape in the immediate vicinity of the proposed action has been through recreational, timber harvesting, and geothermal activities. Recreational activities have resulted in the establishment of campgrounds, summer homes, and support facilities, which are visible primarily near Medicine Lake. Timber harvesting and logging activities have resulted in cleared areas throughout the vicinity of the proposed action.

Previous authorized geothermal drilling activities have also resulted in cleared areas for well pads within the Glass Mountain KGRA. The cleared areas associated with geothermal drilling activities are generally smaller in size than those areas cleared by timber harvests. Logged areas have been used for geothermal drilling well pads.

In order to protect visual resources in the Modoc National Forest, the USFS has established five visual quality objectives (VQOs) for the Forest. All areas within the Forest have been assigned a VQO. The primary areas of concern are those areas designated as preservation or retention VQOs. In preservation VQO areas, only ecological changes are permitted. In retention VQO areas, activities may occur that are not visually evident to the casual observer. In determining if a proposed use would meet the preservation or retention VQOs, the following aspects of the proposed use are considered:

- The nature of the proposed use
- The physical capability of the landscape to absorb the modification associated with the proposed use
- The visual sensitivity of the area

The other three VQOs are partial retention, modification, and maximum modification. Areas with these designations allow increasing levels of visual modification from activities. Table 3.8-1 identifies the VQO designations for each of the proposed well pad sites. None of the proposed facilities would be located in an area with a preservation designation.

Table 3.8-1: VQO Designations for Proposed Well Pad Sites[1]

Well Pads	Visual Quality Objective
34-8TCH	Modification
42-13TCH	Partial Retention
11-24TCH	Partial Retention
15-15TCH	Partial Retention
63-20TCH	not designated
18-32	Retention
46-32	Partial Retention
58-6	Modification
56-18	Retention
13-18	Partial Retention

Notes:

[1]Proposed access road corridors to well pads generally have the same VQO designation as the well pad.

SOURCE: USFS 1991a

3.9 Land Use, Recreation, and Transportation Systems

LAND USE

The vicinity of the proposed action is generally an undeveloped, forested area that has relatively little human occupation and provides a variety of recreational opportunities. The area is also used for selective commercial logging activities. The few residential uses that exist in the vicinity of the proposed action are primarily summer homes clustered near Medicine Lake. The inaccessibility of the region during the winter months due to snow limits the land uses in the area.

Well pad sites 18-32 and 46-32 are located in the USFS-designated Mount Hoffman Roadless Release Area (RRA). The RRA is a 10,800-acre area located north of Medicine Lake that has been provided protection by the USFS. RRAs are areas that have been released from current consideration for designation as Federal Wilderness Areas, but that could be considered for Wilderness Area designation at a later date.

The proposed action would be located on Federal Geothermal Leases CA-12367, CA-12370, CA-12371, CA-12372, CA-1224, and CA-2500. Of these six leases, four (CA-12367, CA-12370, CA-12371, and CA-12372) carry special stipulations that restrict surface occupancy within portions of the lease areas. These special stipulations, referred to as "no surface occupancy" lease stipulations, prohibit occupancy by a proposed action of specified portions of the leases if the action would result in significant adverse impacts. If it can be proved that there would not be a significant adverse impact from a proposed action, the no surface occupancy restriction would be lifted.

The no surface occupancy stipulations on portions of CA-12367 and CA-12372 apply to areas within these leases that are either on or in the vicinity of the Glass Mountain lava flow. The stipulations prohibit occupancy unless it can be demonstrated that the proposed action would not have a significant adverse impact on this unique lava flow and associated geologic features. The no surface occupancy stipulations on portions of CA-12370 and CA-12371 are related to protection of recreational uses. The stipulations prohibit occupancy unless it can be demonstrated that the proposed action would not have a significant adverse impact on recreational uses. Of the 10 proposed well pads, only well pad 42-13TCH is located within a no surface occupancy lease stipulation area (related to recreational uses).

The project area does not include any farmland or Areas of Critical Environmental Concern.

RECREATION

In the vicinity of the proposed action, there are two types of USFS-designated recreational areas: developed recreation areas and dispersed recreation areas.

Developed Recreation Areas

Developed recreation areas are all located within the boundaries of the USFS-designated Recreation Management Area (RMA), which is generally centered on Medicine Lake. Most of the developed recreation uses within the RMA are located on the shores of Medicine Lake. All of the proposed well pads (except for 63-20TCH, 18-32, and 46-32 and associated access roads) would be located within the RMA.

Typical developed recreational activities that occur in the vicinity of the proposed action include camping, fishing, picnicking, boating, swimming, and hiking. Snowmobiling and cross-country skiing also occur during the winter season. There are four developed campgrounds in the vicinity, all of which are located on the northern and western shores of Medicine Lake:

- Medicine Lake Campground (22 camp sites)
- A.H. Hogue Campground (24 camp sites)
- Hemlock Campground (19 camp sites)
- Headquarters Campground (8 camp sites)

The operating season for the campgrounds is July through October. Although busy at certain times of the year (e.g., holiday weekends), these campgrounds are rarely ever full.

In addition to the camp areas around Medicine Lake, a public day-use picnic area, swimming area, and boat launching ramp are located on the southeastern shore of the lake. Other developed recreational facilities at Medicine Lake include three recreation residences (under special use permit from the USFS) and about 100 recreation residences located on private lands adjacent to the lake. These residences are generally accessible only during the summer months, but can be occasionally accessed in the winter when weather conditions allow.

Dispersed Recreation Areas

The proposed locations of well pads 63-20TCH, 18-32, and 46-32 are outside of the RMA, and are thus considered to be located in dispersed recreation areas. These areas have not been (and are not planned to be) developed for intensive recreation use. Big game hunting and recreational driving on the many primitive roads in the Modoc National Forest are the primary recreational activities that occur in dispersed recreation areas. Camping, nature study, hiking, and off-road vehicle use are other typical recreational activities that occur in these areas.

June through October are the primary months of dispersed recreation area use due to cold weather and snow during other times of the year. However, dispersed recreation areas are used during the late fall, winter, and spring months for recreational activities such as cross-country skiing and snowmobiling.

TRANSPORTATION

The vicinity of the proposed action is well accessed by several existing paved and gravel-surfaced arterial roads, as well as many gravel-surfaced collector roads. Traffic volumes roads in the vicinity are very low and are typical of rural areas with sparse human populations. The primary access routes in the vicinity are:

- Medicine Lake Highway (Modoc County Road 97), a paved two-lane arterial providing access from State Highway 139 to the east of the proposed action
- Powder Hill Road (43N49), a paved two-lane arterial providing access from State Highway 89 through the Shasta National Forest to the southwest of the proposed project area. This arterial also connects with 42N24, an arterial providing access from Modoc County Road 91 to the southeast of the proposed action
- Lava Beds Monument Road (47N75) a partially paved, partially gravel-surfaced, primarily single-lane (with turn-outs) arterial providing access from the Klamath Basin to the north of the proposed action through the Lava Beds National Monument
- Davis Road (45N05) a paved two-lane arterial providing access from Macdoel to the west of the proposed action on the Klamath National Forest

There are also several gravel-surfaced roads that criss-cross the vicinity of the proposed action, as well as many unimproved dirt access and spur roads. These roads have been established primarily to support timber harvest activities and to provide access to more remote parts of the Forest. USFS personnel frequently use these roads, as do hunters, campers, and other recreationalists. Geothermal exploration companies have also used these roads to access existing geothermal well pads. Travel on area roads occurs primarily during the summer months since this is the period of highest Forest use.

With the exception of the site of well pad 46-32, all of the proposed well pads are currently connected by existing spur roads or old logging skid roads to improved roads in the vicinity of the proposed action. However, only well sites 15-15TCH, 63-20TCH, and 13-18 are currently accessible by vehicle. The existing access routes to the remaining well pads have been overgrown with vegetation and require varying degrees of improvement to provide adequate access for project trucks and vehicles (see Table 2.1-1).

In the immediate vicinity of Medicine Lake, the USFS has paved some roads (such as Road 43N48, which runs along the northern shore of Medicine Lake) in order to better accommodate recreational traffic. However, these roads have received only a thin surface pavement, and are not designed to handle heavy loads such as logging or water trucks. The USFS is concerned that heavy truck loads could break up and destroy the pavement along these roads (Sharp 1994).

3.10 Socioeconomics

POPULATION

As of 1992, the population of Modoc County was 10,130, and the population of Siskiyou County was 44,791 (California Department of Finance 1992). Population growth rates in

Modoc and Siskiyou Counties from 1980 to 1990 were 12% and 13% respectively. In-migration accounted for 75% to 80% of the increase. This pattern is consistent with national trends showing movements from urban areas to more rural settings.

The population of Modoc and Siskiyou Counties are expected to increase at an average annual rate of 1.3% and 0.8% respectively. Both Modoc and Siskiyou County populations are expected to increase at rates below the anticipated statewide annual growth rate of 1.8%.

The average age of the population in Modoc and Siskiyou Counties is increasing as a result of a poor job market in the 18- to 24-year-old group, and the in-migration of older-age groups (primarily for retirement). Modoc and Siskiyou Counties have higher percentages of people in the 50-and-older age class (33% and 32%, respectively) than the rest of the State (25%).

The 1990 census reports the population density of Modoc County to be 2.4 people per square mile and 7.1 in Siskiyou County. These population densities are considered sparse when compared to the state average of 156 people per square mile.

EMPLOYMENT

The principal economic resources of Modoc and Siskiyou Counties are government employment, timber, agriculture, and recreation (see Table 3.10-1). The National Forest affects the agricultural sector by supplying livestock forage on public lands, which many ranches include as an integral part of their total operations. Recreation, particularly hunting, fishing and camping on forest land, affects the wholesale and retail trade and services sectors. Within the manufacturing sector, lumber and wood products (timber harvesting and mill work) comprise over 90% of total manufacturing employment. Timber also has a strong effect on the construction sector due to road construction and reconstruction requirements to transport harvested lumber.

Table 3.10-1: Comparison of Percent Employment by Sector

Economic Resource	Modoc County (%)	Siskiyou County (%)	State (%)
Government	36	30	16
Agriculture and Forestry	12	6	<2
Wholesale and Retail Trade	16	22	24
Services	23	16	27
Manufacturing	6	15	18
Construction	<5	<5	<2

SOURCE: USFS 1991a

Unemployment rates in Modoc and Siskiyou Counties are subject to seasonal fluctuations. Unemployment reaches a peak during winter months when harsh weather hampers timber harvesting, farming, and ranching. In-migration from urban areas has occurred at a faster rate than employment opportunities have increased and has contributed to the high unemployment rates in Modoc and Siskiyou Counties. Between 1982 and 1989, Modoc and Siskiyou County unemployment rates in exceeded Statewide averages for the same period. During this time, Modoc County's unemployment rate ranged from 7% to 12%, Siskiyou County's unemployment rate ranged from 11% to 23%, and the state's unemployment rate ranged from 5% to 10%.

HOUSING

The total housing in Modoc County in 1992 was 4,791 housing units, which includes 1,090 mobile homes. The 1992 vacancy rate in Modoc County was 20.08% (California Department of Finance 1992). Modoc County's housing supply is divided into the unincorporated County of Modoc and the City of Alturas. Approximately 73% of the households in unincorporated Modoc County are owner occupied and 27% are renter occupied. Alturas households are 64% owner occupied and 36% renter occupied (Modoc County 1993).

Additional temporary housing in Modoc County consists of 10 recreational vehicle parks (RV parks) and 11 motels (Heiser 1994). Alturas has four trailer parks, one RV park and nine motels (Heiser 1994; Taylor 1994). Motels are also located nearby in the towns of Cedarville and Canby. There are 24 campgrounds in the Modoc National Forest that provide approximately 300 camp sites. These campgrounds are open during only the summer and early fall months. Four of these campgrounds, providing 73 camp sites, are located in the immediate vicinity of the proposed action (see Section 3.9, Land Use, Recreation, and Transportation Systems).

The total housing in Siskiyou County in 1992 was 20,535 housing units, which includes 3,642 mobile homes. The 1992 vacancy rate in Siskiyou County was 13.33% (California Department of Finance 1992). Additional temporary housing in Siskiyou County consists of approximately 20 RV Parks, and over 78 inns and motels (Breedon 1994; Ward 1994).

There are about 100 residences in the vicinity of the proposed action. These homes are used as recreational or second homes and are not occupied year round. The homes closest to the proposed action are approximately one to two miles away and are located on the southwest shore of Medicine Lake. Property values of these homes range from about $30,000 to $125,000 and depend on the condition of the home, type of property improvements, and the date of the last property appraisal (Sharp 1994).

4: ENVIRONMENTAL CONSEQUENCES AND MITIGATION MEASURES

4: ENVIRONMENTAL CONSEQUENCES AND MITIGATION MEASURES

4.1 Introduction

This chapter describes the expected environmental effects of the four alternatives, including the proposed action. The discussion focuses on those effects that could potentially be significant and/or were raised during the public scoping period for the POO. For each effect, the significance of the effect is discussed, and any necessary mitigation measures to reduce the effect and ensure that the effect would not be significant are identified. Significance criteria for each parameter are based primarily on Appendices G and I of CEQA. The analysis of the impacts of Alternatives B, C, and D focuses on the effects that would be different from those identified for the proposed action (Alternative A). A Mitigation Monitoring and Reporting Program (MMRP) for the proposed action is provided in Appendix C.

4.2 Geology and Soils

SIGNIFICANCE CRITERIA

Geology-related impacts that could be considered significant include:

- Topographic changes which lead to other adverse impacts (e.g., visual impacts or impacts on slope stability)
- Adverse affects on unique geologic or topographic features
- Substantial subsidence
- The prevention of the recovery of significant mineral resources

- Exposing people or structures to major geologic hazards
- Causing substantial erosion or siltation

EFFECTS OF ALTERNATIVE A

4.2.1. Geologic Hazards

Slope Stability: All of the proposed project facilities would be located in areas of gentle to moderate slopes of under 30% and in areas of stable soil types. The proposed action would therefore not cause or be affected by unstable soils or slopes.

Seismicity: The proposed action would not cause an increase in seismicity in the area. Induced seismicity is generally related to injection of geothermal fluids under high pressure. For example, at the Denver Arsenal, injection of fluids at 8,000 to 10,000 pounds per square inch (psi) was found to increase seismicity (Colorado School of Mines 1967). However, the proposed action would not involve the injection of geothermal fluids under high pressure. There would be limited volumes of geothermal fluids produced, and high-pressure injection is not proposed during the exploration and testing phase of the proposed action. If any fluids were returned to the reservoir, they would be injected under atmospheric pressure or at very low pressures of only a few pounds. Experience at the Coso and other geothermal fields has shown that geothermal exploration has not increased the level of earthquakes felt by humans in the region.

Ground shaking associated with a seismic event in the region would not damage the subsurface casings. Fill slopes would be compacted to reduce the effect of ground shaking. The equipment associated with drilling rigs and well testing is not considered to be excessively hazardous during seismic events. Workers would therefore not be exposed to excess level of hazard during drilling or testing operations.

Volcanic Hazard: The proposed action is located in a potentially active volcanic area, but would not increase the potential for volcanic hazards. The USGS indicates that an eruption of the Medicine Lake Highlands would be similar to previous eruptions—comparatively non-catastrophic. Based on that assumption, some general hazards associated with such an eruption can be predicted.

From a geologic perspective, a volcanic eruption in the area would not be expected to be violent. An eruption would be accompanied by gases and deposits of ash, pumice, and cinders. The amount of deposit could be 20 to 50 feet deep, depending on the distance from the source of the eruption. Surface flows of hot molten lava and mud would not be expected to be extensive. As mud flows are ejected from a volcano, they pick up more water as they melt snow, slide through lakes, and eventually flow down exiting drainages. Mud flows occurring as a result of an eruption in the Highlands would not be extensive because few drainages exist in the area.

Because the proposed action is located in a potentially active volcanic area, CEGC employees in the vicinity would be exposed to risk from potential volcanic eruption. However, hazards to workers would be considered extremely remote due to the

infrequency of potential volcanic eruptions and the limited life span of the proposed action. If there is any indication during the life of the proposed action that a volcanic eruption is imminent in the vicinity of the proposed action, CEGC would comply with employee evacuation procedures specified by the USGS, USFS, and BLM. Volcanic events would not be expected to affect wells.

4.2.2. Erosion

Although grading for construction of well pads and roads has the potential to increase erosion, CEGC would prevent erosion through the use of careful site preparation procedures. Standard construction techniques for control of runoff from construction sites would be employed, and construction would be designed to avoid changing existing drainage channels.

At well pads, berms and culverts would be installed if necessary to control erosion and drainage. Pads would be constructed to channel drainage into the sump. Since the pad sites are relatively level, no steep cut or fill slopes would be required. Pad fill slopes would be compacted to reduce gullying and erosion. Topsoils would be stockpiled and spread on slopes to aid in natural revegetation. Upon abandonment, the sites would be restored to their original condition as far as practicable. Any stockpiled topsoil would be replaced and the site would be reseeded and planted to minimize the potential for erosion. Construction and use of well pads would therefore not significantly increase the potential for erosion.

For construction of roads, erosion would be controlled by using Best Management Practices (BMPs). Water bars, outslope roads, road ditches, and rocked drainages would be used for erosion control along roads. Upon completion of the project, roads that would be abandoned would be restored to their original condition as far as practicable. Road corridors would be reseeded and planted to minimize the potential for erosion. Construction and use of roads would therefore not significantly increase the potential for erosion.

4.2.3. Subsidence

Subsidence is a potential hazard associated with the withdrawal of geothermal fluid from a reservoir. However, due to the limited volume of geothermal fluids that would be produced during well testing, and the demonstrated competence of the volcanic rocks in the region, no subsidence is expected to result from the proposed drilling and testing.

4.2.4. Topography

The proposed action would involve grading up to five TCH well pads measuring approximately 60 feet by 100 feet, five exploration well pads measuring approximately 400 feet by 600 feet, and approximately 2,600 feet of new roads, for a total of 29.6 acres of surface disturbance.

Major cut and fill operations would not be necessary at TCH sites due to their limited size, the fact that they would not require construction of a large earthen sump, and their location on old log landings. At the end of the life span of the proposed action, TCH well

pads and associated access roads would be recontoured approximately to pre-project conditions.

To the greatest extent possible, the proposed deep exploration well pads have also been sited on relatively level sites. The creation of minor cut and fill slopes would be necessary at certain exploration well pads. Cut and fill would be balanced at each well pad, and would not significantly alter the topography of the area.

Roads would be limited to the narrowest width that would allow safe passage to the site and would be constructed as Class D single-lane resource roads, according to USFS specifications. Minor balanced cut and fill would be required for roads, but would not significantly alter the topography of the area. Specific details of proposed road construction would be submitted to the BLM, by CEGC Geothermal Sundry Notices (CEGC 1994).

At the end of the life span of the proposed action, the exploration well pads and associated access roads would either be recontoured to pre-project conditions (if a well is unproductive or if the geothermal resource proves to be not commercially viable) or left "as is" for further use (if the resource is commercially viable and CEGC decides to pursue development and utilization of the resource). An analysis of continued use of selected wells and access roads would be conducted as part of the environmental review for any future Plans of Development or Utilization submitted to the BLM and USFS.

Given the limited extent of proposed grading activities and the recontouring to pre-project conditions that would occur, the proposed action would not represent major changes to existing topography.

4.2.5. Unique Geologic Features

Wells 46-32, 18-32, 58-6, and 34-8TCH would be located near the Glass Mountain Lava Flow, as would the access road for well 46-32. This lava flow is considered to be a unique geological feature and is identified as a Geologic Special Interest Area by the USFS. Portions of the Glass Mountain Unit Area that include the Glass Mountain Lava Flow have no surface occupancy lease stipulations attached to geothermal leases. This stipulation prevents surface activities within the Glass Mountain Lava Flow. However, none of the components of the proposed action would occur within the designated no surface occupancy areas. In addition, none of the components of the proposed action would be located closer than 200 feet to the lava flow; this would be adequate to avoid affecting this unique geological feature.

4.2.6. Recovery of Mineral Resources

The only mineral extraction activities in the vicinity of the proposed action are several small rock quarries used by the USFS to supply road-building materials. There are no features of the proposed action that would occupy areas of known surface or subsurface mineral resources. The proposed action would therefore not prevent the recovery of any mineral resources.

4.2.7. Geothermal Resource

The proposed action would involve limited exploratory drilling and testing of the geothermal resource within the Glass Mountain KGRA. Geothermal fluids would only be removed from the resource during testing activities at the exploration wells. Given the limited extent and duration of proposed geothermal drilling and testing (30 to 90 days), the proposed action would not be expected to have a significant effect on or affect the life expectancy of the geothermal resource.

The proposed action would allow only exploratory drilling and testing, and would not include development or utilization of the geothermal resource. An analysis of effects to the geothermal resource from development and utilization would be considered speculative at this time. If CEGC decides in the future to pursue development and utilization of the resource, CEGC would submit the appropriate plans to the BLM and USFS. The effects of proposed development and utilization (construction and operation of a power plant) on the geothermal resource would then be subject to environmental review.

4.2.8. Well Blow-Out Hazards

Blow-outs are accidental, uncontrolled releases of geothermal fluids such as steam, gases, or hot water from a geothermal well during drilling operations. The potential effects of accidental releases of geothermal fluids include pollution of surface and shallow groundwater resources, hazards to workers' health and safety, and air contamination from emissions of gases such as hydrogen sulfide (see Section 4.6 for a discussion of potential effects to air quality from well blow-outs).

The risk of a blow-out during proposed drilling operations at the well pads would be considered low. The conditions that increase the potential for blow-outs to occur include:

- Drilling in incompetent rocks (soft, sedimentary rocks)
- Use of inadequate casing and cementing
- Use of inexperienced drillers

None of these conditions would occur with the proposed action. Drilling would be accomplished in the highly competent, volcanic rocks that have been demonstrated to exist in the vicinity and that are expected to be encountered at depth. In addition, the drilling program that would be implemented under the proposed POO includes required well control programs. These control programs include installation of blow-out prevention (BOP) equipment, periodic equipment testing, and safety drills. CEGC also proposes to use adequate casing and cementing, as well as experienced drilling personnel. These measures would minimize the potential for blow-outs.

In the highly unlikely event that a blow-out does occur, the effects to the environment would not be expected to be significant. In a TCH well, the small diameter of the well (2.5-inch inside diameter of the well bore) would prevent large quantities of fluids from escaping into the surrounding environment. Exploration wells are drilled with return of drilling mud, which greatly reduces the potential for blow-outs.

If a blow-out does occur, the majority of the geothermal fluid resulting from the blow-out would be expected to drain into the on-site sump, and CEGC would take immediate measures to control and correct the blow-out. Since the sumps would be constructed of impermeable materials, shallow groundwater resources would not be expected to be affected. Surface waters would also not be expected to be affected as all geothermal fluids would be expected to be contained at the site.

There is the potential that workers at the site of a potential blow-out could be harmed by the geothermal fluids or release of gases (particularly hydrogen sulfide). The Emergency Contingency Plan included as part of the POO includes measures that would reduce the potential for harm to employees from blow-outs, including the use of hydrogen sulfide monitors and alarms at each drilling rig. With the implementation of these safety precautions (and the low risk of well blow-outs), the risk to workers from well blow-outs would be considered low. Of the hundreds of geothermal wells in the United States, the Geothermal Resources Council has records for only seven blow-outs.

4.2.9. Geothermal Fluid Hazards

In the event of a blowout (discussed in 4.2.8. Well Blowout Hazards), workers could be exposed to geothermal fluids. The primary risk from geothermal fluids would be burns that could result contact with from either steam or hot fluid escaping from the well. Standard safety procedures for blowouts would limit this risk to a very low level. There is also the potential for workers to come in contact with geothermal fluids that are brought to the surface during the course of normal drilling and testing. Table 3.2-1 shows the constituent analysis for typical geothermal fluids from the Glass Mountain KGRA. The primary constituents are chloride compounds which, although somewhat corrosive to metals, are not considered hazardous to humans during skin contact.

Workers could also come in occasional contact with drilling muds during the drilling of the five deep exploration wells. All drilling fluids would be non-toxic, as defined by the EPA and Cal EPA, and hazardous wastes would not be produced. Although typical drilling muds are somewhat alkaline, brief skin contact with these muds is not considered to be hazardous to drill rig workers. See 4.3.2 in Section 4.3, Water Quality for a discussion of disposal of drilling fluids.

MITIGATION MEASURES

Although the proposed action would not result in significant adverse effects to unique geologic features or significantly increase the potential for erosion, the following mitigation measures are recommended to avoid adverse effects:

Mitigation Measure 4.2.1.

In order to protect the obsidian flow near pad 58-6, well pad facilities will be located 200 feet from the toe of the obsidian flow. No surface disturbance or activity will occur in the area between the edge of the pad and the toe of the obsidian flow.

Mitigation Measure 4.2.2.

Erosion controls (such as vegetated buffers and grass stabilization) will be used as prescribed by the USFS to protect surrounding undisturbed vegetation and down-slope areas. Erosion controls will stay in effect and be maintained until construction at the well pad site is completed or all of the cleared land at the well pad site is stabilized with new ground cover.

EFFECTS OF ALTERNATIVES B, C, AND D

Alternative B

The effects of Alternative B, elimination of pads 42-13TCH and 15-15TCH, would be similar to those of the proposed action (Alternative A). If Alternative B is selected, the potential for geologic hazards to affect people or facilities at those sites would be eliminated. There would be no potential for erosion at the two sites and the 0.28-acre area of the well pads would not be graded, reducing the alteration of topography in the area. With two fewer wells, there would be a lower potential for blow-out. If the two TCH wells are not drilled there would be less information obtained about the regional extent of the geothermal reservoir at this time. Mitigation Measures 4.2.1 and 4.2.2 would apply to this alternative.

Alternative C

The effects of Alternative C, elimination of pads 18-32 and 46-32, would be similar to those of the proposed action (Alternative A). If Alternative C is selected, the potential for geologic hazards to affect people or facilities at those sites would be eliminated. There would be no potential for erosion at the two sites and the 12-acre area required for the well pads and access road would not be graded, reducing the alteration of topography in the area. With two fewer wells, there would be a lower potential for blow-out. If the two exploration wells are not drilled there would be less information obtained about the regional extent and potential of the geothermal reservoir. Mitigation Measures 4.2.1 and 4.2.2 would apply to this alternative.

Alternative D

There would be no geologic effects from implementation of Alternative D, the no action alternative. Under this alternative, no additional knowledge would be gained about the geothermal reservoir character and extent. No mitigation would be required under this alternative.

4.3 Hydrology

SIGNIFICANCE CRITERIA

The proposed action would be considered to have a significant impact on the environment if it would:

- Substantially deplete or degrade groundwater resources
- Change the amount of surface water in any water body

- Contaminate a public water supply
- Substantially degrade water quality
- Interfere substantially with groundwater recharge
- Cause substantial flooding, or expose people or property to water-related hazards such as flooding

EFFECTS OF ALTERNATIVE A

4.3.1. Depletion of Water Resources

Water consumption would primarily occur during the drilling phase of the proposed action. CEGC currently proposes to obtain all water for well drilling and coring activities from the two existing wells in the Arnica Sink area. However, CEGC could obtain water for drilling at well 63-20TCH and 15-15TCH from existing wells such as Pumice Stone or Harris Springs located approximately five to six miles west of Little Mount Hoffman (see Figure 1.1-2) if required, due to their distance from the Arnica Sink wells. In addition, if any wells prove to be successful, produced fluids from these wells would be used where feasible to reduce the need for water from other sources (CEGC 1994).

Water would be needed primarily to create drilling mud, which is a mixture of water and clay. Drilling mud would be used to cool and lubricate the drill bit and to remove cuttings from the well hole. Proposed TCH drilling would require approximately 3,000 to 5,000 gallons of water per day. Exploratory wells would require approximately 9,000 gallons per day and up to 40,000 gallons could be required in lost circulation zones.

Each TCH would take from 25 to 60 days to drill, and each exploration well would take 60 to 90 days to drill. Proposed geothermal drilling would take place over several years, and water use would be spread out over time. Geothermal drilling would therefore not significantly deplete water resources in the vicinity. No water would be withdrawn from Medicine Lake.

Water could also be used during grading of roads or drill pad sites if needed to suppress dust (CEGC 1994). Water would be trucked to the construction locations from the water wells near the Arnica Sink. The quantity of water needed for dust suppression would be relatively small compared to the amount of water used for drilling activities, and would be used for a very short time (one to two days for each TCH well, and about two weeks for each exploration well). Water use for dust control would therefore not significantly deplete water resources in the vicinity, including Medicine Lake.

Proposed activities would not affect the water levels in Medicine Lake because the wells would be cased and cemented and only geothermal fluids from the deeper geothermal reservoir below 3,000 feet deep would be withdrawn from the exploration wells. Implementation of the USGS hydrologic monitoring plan for the Glass Mountain area (USGS 1994) would provide a mechanism for monitoring lake levels and spring discharge.

4.3.2. Water Quality

The five deep exploration well pads would require construction of sumps with a capacity of approximately 1,000,000 gallons. The sumps at the these well pads would be adequately sized to contain the anticipated volumes of drilling muds and fluids produced during testing. All drilling fluids would be formulated to be non-toxic, as defined by the EPA.

During drilling at the exploration well pads, water, mud, and drill cuttings would be discharged to the sump; if the solids separation process is used, geothermal fluids would be discharged to the sump, and de-watered drill cuttings and other solids would be stored in containment pits in other containers on the drill pad sites. Sumps would be lined with clay to a permeability of 10^{-6} cm/sec to avoid the potential for percolation of drilling or produced fluids to affect any shallow groundwater. At least two feet of freeboard would be maintained in sumps to minimize the risk of overflows. Water would be recirculated from the sump to the drilling mud systems as a conservation measure. Heavy rains could result in the need to truck excess water that collects in the sump to an approved dumpsite or inject the water into an injection well. After completion of the well, the sump contents would be solar dried if possible, mixed with native soils, and buried in the sump, or hauled by truck to an approved dump site.

TCH wells would not produce geothermal fluids; sumps would therefore not be required at the TCH well pads. These well pads would include a reserve pit to provide for emergency storage of any leaked drilling fluids. The 10 foot by 25 foot reserve pit would be constructed within the footprint of the well pad, and would be lined with plastic to prevent percolation of any fluids that might be contained in the reserve pit. Lining of the pit would ensure that groundwater quality would not be affected.

As discussed in Chapter 1, Introduction, the discharge of drilling and/or geothermal fluids to the well pad sumps would be regulated under a permit issued by the Central Valley Regional Water Quality Control Board, and would be accomplished in accordance with the GROs, stipulations of the BLM and USFS, and all applicable permits and regulations.

Surface Water: Surface water quality could potentially be affected if runoff, drilling fluids, or geothermal fluids were allowed to enter surface drainage systems in the vicinity of the proposed action. However, this would not occur due to the design features incorporated into the proposed action. Pads would be prepared to drain internally to prevent any accidental spills from leaving the drill pad. Should they occur, accidental spills would be managed as set forth in the CEGC Emergency Contingency Plans. Additionally, none of the proposed well sites are located near surface water. The surface water closest to a proposed well pad is Paynes Springs, which is approximately 0.4 miles southeast of well pad 56-18.

In addition to the design features that would prevent surface water contamination, the proposed action would not affect the water quality of Medicine Lake due to the distance of the drill pads from the lake and the fact that many of the well pads are located in basins

that drain away from Medicine Lake. The drill pad that would be closest to the lake is pad 42-13TCH, which is 0.7 miles from the east end of Medicine Lake. Implementation of the USGS hydrologic monitoring plan for the Glass Mountain area (USGS 1994) would provide for monitoring water quality at the lake and other surface waters in the area.

Road construction and construction of TCH well pads could result in a negligible increase in runoff that would be absorbed in non-disturbed areas. The limited new road construction and associated improvements would incorporate standard drainage improvements and BMPs required by USFS. The limited amount of increased runoff from road and TCH pad construction would not significantly affect surface water quality.

Groundwater: Groundwater quality could be adversely affected if drilling fluids or geothermal fluids were allowed to enter subsurface aquifer formations or if contaminated runoff were allowed to infiltrate the groundwater system in recharge zones. However, the fluids produced during well drilling and testing would not reach groundwater aquifers due to the design features incorporated into the proposed action. Implementation of the USGS hydrologic monitoring plan for the Glass Mountain area (USGS 1994) would provide a mechanism for monitoring groundwater quality in the area.

The proposed exploration wells and TCH wells could pass through a number of aquifers during the drilling phase. If not properly drilled and cased, drilling fluids and geothermal fluids could enter shallow aquifer systems, or water could move through the well bore from one aquifer to another. However, the proposed exploration and TCH wells would be cased and cemented in accordance with the GROs to prevent geothermal fluids from entering shallow groundwater zones. Standard casing procedures are highly effective in preventing aquifer contamination. Adverse effects to groundwater are therefore not expected.

Construction of the five exploration well pads would result in compaction and grading of soils at the pads and would divert precipitation into the sumps or drainage areas instead of allowing it to infiltrate. Given the small area occupied by each pad (about five acres), the proposed action would not significantly affect groundwater discharge in the vicinity.

Paynes Springs is located approximately 0.4 miles southwest of well 56-18. There is the concern that drilling at well 56-18 could affect water quality at Paynes Springs by introducing muds into the groundwater aquifer that feeds the spring area. Any effect that could occur would be expected to occur during the shallowest drilling at well 56-18, due to the elevations of the well pad and the spring area. However, this is unlikely for several reasons. The first 350 feet of drilling would occur rapidly, usually within one to two days. Shallow aquifer zones would then be cased before drilling into deeper formations to prevent any contamination of these aquifers by drilling muds, water from other aquifers, or geothermal fluids. Additionally, drilling muds used during shallow drilling are generally composed almost entirely of water, with small amounts of bentonite (a natural clay material). Any minor amounts of drilling mud that would enter the aquifer would be diluted in the groundwater and would not exist at sufficient concentrations to adversely affect the water by the time it migrates the 0.5 mile distance to Paynes Springs. The

potential for the proposed action to adversely affect Paynes Springs is therefore considered unlikely.

4.3.3. Loss of Drilling Fluids

CEGC would use two different methods to drill the TCH wells and the exploration wells that are proposed under the POO (see Section 2.1). For the TCH wells, CEGC would drill the wells by allowing the drill bit to advance without maintaining circulation of drilling fluid from the drill bit back to the surface. For the exploration wells, CEGC would attempt to maintain pressure so that the drill cuttings are floated to the surface by the drilling fluids. Under both drilling methods, there is the potential that drilling fluids could flow into subsurface porous rock formations and/or aquifers (known as "lost circulation"). However, the TCH and exploration well drilling fluids would not significantly affect groundwater or surface water resources in the area. A discussion of each drilling method and why it would not affect hydrology in the area follows.

TCH Well Drilling: The drilling of TCH wells would require the use of drilling fluids (i.e., water and non-toxic muds and additives) primarily to lubricate the drill bit as it passes through subsurface rock formations. The drilling method used to drill a TCH well under the proposed POO would be similar to the drilling method that is typically used to drill a water well. Only the first 550 feet of the 5,500 TCH wells would be cement cased; the remaining depth of the well would be drilled using standard diamond drilling equipment with no casing (see Section 2.1).

When drilling a TCH well, drilling fluids would be applied as the drill bit advances, and the drill bit (which has a hole in its center) would form a cylindrical rock core. Every 10 to 15 feet, a core barrel would be sent down the core hole to retrieve the rock core and bring the core to the surface. By coring the rock, the majority of the rock material would be mechanically removed intact through the core recovery. Rock material that would not be retrieved would be ground into minute particles by the drill bit as it advances.

Since TCH wells would be drilled without maintaining circulation of drilling fluid from the drill bit back to the surface, drilling fluids and ground rock could flow into any porous subsurface formations or aquifers that are encountered during drilling. However, the areal extent of any drilling fluid or ground rock migration would be limited due to the nature of the subsurface formations and the temporary and minor use of the drilling fluids. In addition, only non-toxic drilling fluids would be used in drilling TCH wells; the fluids would therefore not substantially degrade or adversely affect any local aquifers that could be encountered during drilling. Experience at other geothermal drill sites has indicated that temporary and minor release of drilling fluids in subsurface formations does not pose a significant threat to underground aquifers. The drilling of TCH wells would therefore not be expected to adversely affect the hydrologic system in the vicinity of the proposed TCH drill sites.

Exploration Well Drilling: The drilling of exploration wells would require the use of drilling fluids to lubricate the drill bit as it passes through subsurface rock formations. In

addition, drilling fluids for these wells would be used to float drill cuttings to the surface, where the cuttings would be separated from the drilling fluids and stored until disposal (drilling fluids would be recirculated to the drilling operation). Circulation of the drilling fluids would therefore need to be maintained in the well bore during exploration well drilling, and CEGC would attempt to minimize lost circulation. Exploration wells would be drilled to a depth of approximately 9,000 feet, with cement casings and a production liner used to maintain pressure and prevent the flow of drilling fluids into any porous subsurface formations or aquifers that are encountered during drilling (see Section 2.1).

During exploration well drilling, there is the potential for lost circulation in certain types of subsurface formations (such as porous or fractured volcanic rock) during the brief period during drilling through the formation and before the well can be cased or lined. However, the potential flow of drilling fluids during drilling would be temporary and minor, and the nature of the subsurface formations would limit the areal extent of any drilling fluid migration. Since only non-toxic drilling fluids would be used in drilling exploration wells, drilling fluids would not substantially degrade or adversely affect any local aquifers that could be encountered during drilling. As noted above, experience at other geothermal drill sites has indicated that temporary and minor release of drilling fluids in subsurface formations does not pose a significant threat to underground aquifers.

If there is severe lost circulation during exploration well drilling, CEGC could use one of two methods to temporarily regain circulation until the well can be cased or lined:

- *Lost Circulation Material (LCM):* LCM is material that is pumped downhole to seal openings in the subsurface formation. Commonly approved materials include cottonseed hulls, cellulose insulation, wood chips, sawdust, and bentonite chips. This technique is only rarely employed in drilling because it tends to clog up the drill pipe and bit ports and to restrict the flow of drilling fluid.
- *Air, Foam, or Aerated Mud:* These drilling techniques involve the use of air, foam, or aerated mud instead of or in addition to the normal drilling fluid to combat lost circulation. These enhance the circulation properties of the medium and reduce pressure downhole. In practice, air, foam, or aerated mud have been shown to be limited in their effectiveness.

Use of either of these temporary measures during severe lost circulation would ensure that pressure is regained and that no significant flow of drilling fluids into subsurface formations or aquifers occurs. After the exploration wells are cased and lined, there would be no potential for the drilling fluids to affect groundwater aquifers in the area. The drilling of exploration wells would therefore not be expected to adversely affect the hydrologic system in the vicinity of the proposed exploration drill sites.

MITIGATION MEASURES

Mitigation Measure 4.3.1

In order to verify that no effects are occurring at Paynes Springs from implementation of wells at well pads 56-18 and 13-18, CEGC will collect water samples from the springs before drilling, during initial drilling, after drilling to 500 feet (the equivalent elevation to the springs), and after completion of these wells. If effects are identified after analysis of

the samples, drilling at these wells will be halted until the hydrologic connection to the springs is better understood. BLM and the USFS will compare the samples after they are analyzed.

EFFECTS OF ALTERNATIVES B, C, AND D

Alternative B

The effects of Alternative B, elimination of pads 42-13TCH and 15-15TCH, would be similar to those of the proposed action (Alternative A). If Alternative B is selected, less water would be used during the drilling process, and the potential for depletion of water resources would still be less than significant. The potential for effects to surface water quality would be essentially the same as Alternative A. Development of these two TCH well pads under Alternative A would not be expected to have any effects on water supply or quality at Medicine Lake. Elimination of the two well pads under this alternative would therefore not result in any reduction in potential effects to Medicine Lake. Elimination of the two wells under this alternative would also not result in a decreased potential for effects to groundwater quality. With two fewer wells, the potential for loss of drilling fluids during lost circulation episodes at the two sites would be eliminated. Mitigation Measure 4.3.1 would apply to this alternative.

Alternative C

The effects of Alternative C, elimination of pads 18-32 and 46-32, would be similar to those of the proposed action (Alternative A). If Alternative C is selected, the potential for effects to surface water quality would be slightly less than Alternative A due to elimination of grading at two well pads and one access road. Elimination of the two wells under this alternative would result in a slightly decreased potential for effects to groundwater quality than Alternative A. With two fewer wells, there would be a lower potential for loss of drilling fluids during lost circulation episodes. Mitigation Measure 4.3.1 would apply to this alternative.

Alternative D

There would be no hydrologic effects from implementation of Alternative D. Mitigation would not be required under this alternative.

4.4 Cultural Resources

SIGNIFICANCE CRITERIA

Federal law requires the consideration of effects to historical and cultural resources prior to authorizing any activity, while state law requires the protection of historical and cultural resources. A proposed action would be considered to have a significant effect on cultural resources if it would adversely affect a resource that is listed or has been determined to be eligible for listing on the National Register of Historic Places (NRHP).

At the state level, the CEQA Guidelines provides the framework for evaluating potential impacts of a proposed action on cultural resources. Pursuant to Section 15065(a) of the CEQA Guidelines, the elimination of "important examples of the major periods of California history or prehistory" would be a significant impact on the environment. Appendix G of the CEQA Guidelines states that a project will normally have a significant effect on the environment if it will "disrupt or adversely affect a prehistoric or historic archaeological site or a property of historic or cultural significance to a community or ethnic or social group." Appendix K of the CEQA Guidelines states that a significant negative impact on the environment would be caused by the disruption or destruction of an "important archaeological resource," which is defined as a resource that:

- Is associated with an event or person of recognized significance in California or American history, or recognized scientific importance in prehistory
- Can provide information which is both of demonstrable public interest and useful in addressing scientifically consequential questions
- Has a special quality such as oldest, best example, largest or last surviving example of its kind
- Is at least 100 years old and possesses substantial stratigraphic integrity
- Involves important research questions that historical research has shown can be answered only with archaeological methods

In addition, a proposed action would be considered to have a significant effect if it would significantly interfere with or disrupt Native American uses of an area.

EFFECTS OF ALTERNATIVE A

4.4.1. Prehistoric Resources

Survey and excavations have produced few chronologically sensitive prehistoric artifacts in the Medicine Lake Highlands. No prehistoric sites nor isolated prehistoric finds were discovered at the TCH or exploration well pad locations or associated access roads, and no NRHP-eligible or listed sites have been identified in the immediate vicinity of the proposed action. The proposed action would therefore not affect prehistoric resources.

4.4.2. Historic Resources

No historic sites nor isolated historic finds of significance were discovered at the TCH or exploration well pad locations or associated access roads. No NRHP-eligible or listed historic sites have been identified in the immediate vicinity of the proposed action. The proposed action would therefore not affect historic resources.

4.4.3. Native American Concerns

The Medicine Lake area is used by several Native American groups, primarily for spiritual and cultural heritage purposes. No Native American uses have been identified in areas that would be directly affected by implementation of the proposed POO; the proposed action would therefore not be expected to have a direct effect on Native American uses within the Medicine Lake Highlands.

Implementation of the proposed POO would result in a relatively small amount (approximately 29.6 acres) of dispersed surface disturbance, and activities would have a short-term duration (30 to 90 days for drilling at each pad, and about 90 days for testing at the exploration pads). The proposed POO would not be highly visible to Native American groups during Native American use of the Medicine Lake area (see Section 4.8, Visual Resources). The noise levels generated by the project would be temporary in nature and sufficiently low so as to not result in significant noise effects (see Section 4.7, Noise). Based on these factors, the proposed action would not be expected to significantly interfere with Native American use of the area and would not represent a significant effect on Native American groups.

The issues of concern raised by Native American groups during the scoping and consultation process are described in Section 3.4 of this document. These issues are addressed throughout Chapter 4 in the appropriate parameter discussion (e.g., concern about visual effects are addressed in Section 4.8, Visual Resources). No significant effects related to these issues are expected to occur.

Although Native American groups have expressed concern over how future utilization and development of the geothermal resource could affect their use of the area, such an analysis is beyond the scope of this document. This EA/IS addresses the effects of the proposed POO. If a commercially viable geothermal resource is discovered within the Glass Mountain KGRA as a result of the proposed POO, utilization and development of the geothermal resource could occur. However, this utilization and development would require the preparation of separate Plans of Development and Utilization. These future plans (if warranted) would describe any detailed plans for construction and operation of geothermal facilities. Similar to the POO, these plans would be subject to environmental review and public comment. The environmental review for these plans would address the effect of these plans on Native American groups.

MITIGATION MEASURES

Although the proposed action is not expected to result in significant adverse effects to cultural resources, the following mitigation measures are recommended to avoid adverse effects:

Mitigation Measure 4.4.1.

If archaeological resources are discovered during excavation for the proposed action, all work in the immediate vicinity will be suspended pending site investigation by the USFS and a qualified archaeologist to assess the materials and determine their significance. If the qualified professional determines that the resource will yield new information or important verification of previous findings, construction in the immediate area will not resume until the USFS and SHPO have been consulted and the resources appropriately evaluated and treated.

Mitigation Measure 4.4.2.

If prehistoric archaeological deposits that include human remains are discovered by the project sponsor or any construction contractors during excavation for the proposed action, the County Coroner will be immediately notified. If the remains are found to be Native American, local Native American groups and the Native American Heritage Commission (NAHC) will be notified within 24 hours. The most likely descendants of the deceased Native American will be notified and given the chance to make recommendations for the remains. If no recommendations are made within 24 hours, remains may be reinterred elsewhere on the property. If recommendations are made and not accepted, the NAHC will mediate the problem.

Mitigation Measure 4.4.3.

If archaeological resources are discovered during excavation for the proposed action and avoidance of these resources is not feasible, evaluation of the resources will be required. An evaluation plan will be prepared that provides for the methodical excavation of resources that would be adversely affected. Only a qualified archaeologist or cultural resources consultant will be allowed to collect any discovered prehistoric resources. The work will be accomplished within the context of a detailed research design and in accordance with current professional standards. The plan will result in the extraction of sufficient volumes of non-redundant archaeological data so as to address important regional research consideration, and detailed technical reports will be prepared to document the findings.

EFFECTS OF ALTERNATIVES B, C, AND D

Alternative B

Similar to Alternative A, implementation of Alternative B would not affect prehistoric or historic resources or Native American use of the area. Mitigation Measures 4.4.1 through 4.4.3 would apply to this alternative.

Alternative C

Similar to Alternative A, implementation of Alternative C would not affect prehistoric or historic resources or Native American use of the area. Mitigation Measures 4.4.1 through 4.4.3 would apply to this alternative.

Alternative D

Implementation of Alternative D would not affect prehistoric or historic resources or Native American use of the area. Mitigation would not be required under this alternative.

4.5 Biology

SIGNIFICANCE CRITERIA

Federal and state endangered species laws require protection of listed endangered or threatened plants and animals. If the proposed action would affect the range of or

eliminate an endangered or threatened plant or animal species, or would result in take of endangered or threatened animal species, this would be considered a significant effect.

The USFS has established a list of 37 Management Indicator Species (MIS) (see Table 3.5-2). If the proposed action would significantly affect the range, result in significant take, or eliminate any of these animal species, this would be considered a significant effect.

Section 15065(a) of the CEQA Guidelines specifies that a lead agency shall find that a project may have a significant effect on the environment when the project has the potential to substantially reduce the habitat of a fish or wildlife species, threaten to eliminate a plant or animal community, or reduce the number or restrict the range of a rare or endangered species. Appendix G of the CEQA Guidelines states that a project would normally have a significant effect on the environment if it would substantially affect a rare or endangered species or the habitat of the species or would substantially diminish habitat for fish, wildlife, or plants. In addition, the Guidelines provide that plant and animal species may be treated as "rare or endangered" even if not on one of the official lists if:

- The survival and reproduction of the species in the wild are in immediate jeopardy
- The species exists in such small numbers throughout all or a significant portion of its range that it may become endangered if its environment worsens
- The species is likely to become endangered in the foreseeable future and may be categorized as "threatened" under Federal law

VEGETATION EFFECTS OF ALTERNATIVE A

4.5.1. Loss of Vegetation

The proposed action would require the clearing of existing vegetation from the well pads and access road corridors. Vegetation at the well pads and in the access roads consists primarily of trees of various ages and sizes, as described in Section 3.5. Lodgepole pine and red fir are the two main conifer types that are found at the well pads and in the access roads. With the exception of well 46-32 and a portion of well pad 18-32, the proposed facilities have been sited at least partially on existing roads or in areas that have been subject to logging activities or other surface disturbances in the past. This would minimize the effect of the proposed action on existing vegetation. Table 4.5-1 summarizes the removal of trees and snags that would occur at each well pad and access road.

Total surface disturbance at the 10 proposed well pads and within the 2,600 feet of new access road would be approximately 29.6 acres. The well pad dimensions (approximately 60 feet by 100 feet for TCH wells, and 400 feet by 600 feet for exploration wells) are designed to allow the required drilling facilities at each well pad site. Improvements to about 8,150 linear feet of existing access road would be required. In some areas, only scattered trees would need to be removed to widen the existing road. In other areas, vegetation (primarily lodgepole pine) that has begun to re-emerge in the access road corridor would need to be cleared to allow vehicle access to the well pad sites.

Table 4.5-1: Tree and Snag Removal at Well Pad Sites and Access Roads

Well Pad	Estimated Trees to be Removed	Estimated Snags to be Removed
34-8TCH	*Well pad:* seedling and saplings *Access road:* seedling and saplings	*Well pad:* None *Access road:* None
42-13TCH	*Well pad:* seedling and saplings; 5 trees less than 8-inch dbh[1] *Access road:* seedling and saplings	*Well pad:* one 10-inch dbh snag *Access road:* None
11-24TCH	*Well pad:* seedling and saplings *Access road:* seedling and saplings	*Well pad:* none *Access road:* none
15-15TCH	*Well pad:* none *Access road:* none	*Well pad:* none *Access road:* none
63-20TCH	*Well pad:* none *Access road:* none	*Well pad:* none *Access road:* none
18-32	*Well pad:* 10 trees greater than 24-inch dbh; 40 to 60 trees with 15-inch to 24-inch dbh; remaining trees less than 10-inch dbh *Access road:* 80 6-inch to 22-inch dbh trees	*Well pad:* 14 10-inch to 30-inch dbh snags; one 38-inch dbh snag *Access road:* 4 snags greater than 6-inch dbh
46-32	*Well pad:* numerous trees less than 20-inch dbh; two trees greater than 20-inch dbh *Access road:* seedling and saplings	*Well pad:* 17 snags greater than 6-inch dbh *Access road:* one 10-inch dbh snag
58-6	*Well pad:* 150 to 180 trees greater than 15-inch dbh; 600 to 750 trees with 6-inch to 15-inch dbh; remaining trees less than 6-inch dbh *Access road:* 50 6-inch to 12-inch dbh trees	*Well pad:* 3 snags greater than 6-inch dbh *Access road:* none
56-18	*Well pad:* 50 to 60 trees greater than 20-inch dbh; 450 trees with 8-inch to 20-inch dbh; remaining trees less than 8-inch dbh *Access road:* seedling and saplings	*Well pad:* 8 to 10 snags greater than 6-inch dbh *Access road:* none
13-18	*Well pad:* 500 trees greater than 8-inch dbh *Access road:* none	*Well pad:* two to three snags greater than 6-inch dbh *Access road:* none

Notes:

[1]dbh = diameter at breast height

SOURCE: Wildlife Dynamics 1994

All necessary timber removal at the well pads and access road corridors would be conducted in accordance with USFS specifications. In accordance with USFS requests, CEGC would avoid conifer species over 14 inches dbh where feasible. It is expected that commercial timber (i.e., timber with at least a 4-inch dbh on the short end and over 20 feet long) would be limbed and decked for later removal and sale. Brush, removed tree limbs, and other vegetation at the well pads and access road corridors would be scattered in surrounding areas, piled and burned at the well pads, or buried as appropriate at locations designated by the USFS. Tree stumps would be disposed of at a USFS-designated site and would not be buried at the well pad sites.

At the end of the life span of the proposed action, all TCH well pads and associated access roads would be restored to pre-project conditions to the greatest extent possible. TCH well pads would be recontoured to approximately their pre-project contours. Revegetation of the TCH well pads would be expected to occur naturally and relatively rapidly since the TCH pads would receive minimal surface disturbance and soil compaction. More effort would be required to restore TCH access roads to natural conditions. These facilities would be recontoured, scarified to loosen the top soil, and reseeded and planted as necessary with native vegetation.

The fate of the exploration well pads at the end of the life span of the proposed action is unknown at this time. If the geothermal resource proves to be not commercially viable, all of the exploration well pads and associated access roads would be reclaimed in a manner similar to the TCH access roads.

If the proposed geothermal exploration program is successful and the geothermal resource proves to be commercially viable, CEGC would need to decide at that time whether or not to pursue development and utilization of the resource. If development and utilization is not undertaken, the exploration well pads and access roads would be reclaimed in a manner similar to the TCH access roads. If development and utilization is undertaken, CEGC would submit the appropriate Plans of Development and Utilization to the BLM and USFS. These plans would identify which wells could be abandoned (and thus reclaimed), which wells would be used for production wells, and which wells would be used as injection wells. The environmental effects of continued operation of selected wells (including vegetation effects) would be assessed as part of the environmental review for any proposed Plan of Development or Utilization.

Given the limited acreage of vegetation that would be cleared for the well pads and access road corridors, the fact that 9 of the 10 proposed well pads would be at least partially located on previously logged or cleared areas, and the reclamation that would occur at these facilities, the proposed action would not significantly affect vegetation on the Modoc or Shasta-Trinity National Forests.

4.5.2. Special Status Species

No special status plant species have been identified or are known to occur at any of the proposed well pads or the areas of road construction or improvement. The proposed

action would not affect the two special status plant species (talus collomia and northern daisy) known to occur in the vicinity since suitable habitat for these species does not exist at the well pad sites or access road corridors. The proposed action would therefore not affect any special status plant species.

4.5.3. Old Growth Forest

Although most forest habitats in the vicinity of the proposed action have been previously harvested, there are stands of old growth forest dispersed throughout the vicinity. In addition, trees that are of sufficient size and maturity to be considered old growth timber are scattered throughout the vicinity, both in areas that have not been harvested and in areas that have been selectively harvested.

The proposed well pads and access roads would not be located in timber stands that could be considered pure old growth forest; however, certain pads and roads would be located in areas that contain old growth trees. Well pads 46-32 and 18-32, as well as the access road to well pad 46-32, would be located in a previously unharvested area that contains old growth trees. In addition, there are old growth trees located on the uncleared portions of well pads 58-6 and 56-18, which are in areas that have been subject to previous timber harvest. Implementation of the proposed action would require the removal of vegetation (including old growth trees) from these well pads and the access road to well pad 46-32.

The removal of old growth trees from well pads 46-32, 18-32, 58-6, and 56-18 and the access road to well pad 46-32 would not be expected to adversely affect the integrity of the old growth forest in the project vicinity. A total of approximately 23 acres (not all of which contains old growth trees) would be cleared for these well pads and the access road. This affected acreage would represent an extremely small portion of the total forest that contains either old growth stands or scattered old growth trees. In addition, all of these well pads and the access road would be located near existing areas that have either been previously harvested, cleared, or otherwise disturbed.

The potential environmental consequences on wildlife from clearing old growth trees from well pads 46-32, 18-32, 58-6, and 56-18 and the access road to well pad 46-32 are discussed in this section under "Wildlife Effects."

4.5.4. Deposition of Geothermal Fluids on Vegetation

Well testing could result in the release of minor amounts of geothermal fluids to the atmosphere. Deposition of these fluids on the surrounding vegetation downwind of the testing well could occur. Fluids with elevated levels of boron and/or bicarbonate could cause minor, temporary injury to the vegetation upon which it lands.

Extensive monitoring of effects to vegetation from exposure to geothermal fluids from operation of geothermal power plants has been conducted at The Geysers and Coso geothermal fields. Monitoring at The Geysers has indicated that although some injury to vegetation from boron did occur, no long-term vegetation injury could be attributable to

drift from geothermal power plants at The Geysers. At Coso, no adverse effects to vegetation were observed from geothermal operations (USFS et al. 1994).

The proposed action would not be expected to have an adverse effect on vegetation from the deposition of geothermal fluids. In comparison to the power plant operations at The Geysers and Coso geothermal fields, the proposed action would involve only short-term exploration and testing of a geothermal resource. The magnitude of potential releases of geothermal fluids from the proposed action would be significantly less than those that occur from the power plants at The Geysers and Coso. In addition, control measures have been included as part of the proposed POO to prevent the release of geothermal fluids to the atmosphere. Deposition of significant amounts of fluids on surrounding vegetation would therefore not occur.

MITIGATION MEASURES

Although the proposed action would not be expected to result in significant adverse effects to vegetation, the following mitigation measure is recommended to reduce potential effects to vegetation during construction and operation activities of the proposed action.

Mitigation Measure 4.5.1.

Conifers over 14 inches dbh will be avoided where feasible during pad construction. In addition, implementation of Mitigation Measure 4.2.2 will ensure that there would be no erosion effects to vegetation.

VEGETATION EFFECTS OF ALTERNATIVES B, C, AND D

Alternative B

The overall potential for effects to vegetation if Alternative B is implemented would be reduced compared to Alternative A due to the elimination of well pads 42-13TCH and 15-15TCH. There would be about 0.28 acres less area cleared for well pads under this alternative. As with Alternative A, there would be no effects to special status plant species under this alternative. Since the two pads that would be eliminated do not have old growth trees, this alternative would not reduce potential effects to old growth forests. Since the two wells that would be eliminated under Alternative B are TCH wells which do not vent geothermal steam or fluids during testing, there would be no reduction in the potential for effects to vegetation due to deposition of geothermal fluids. Mitigation measure 4.5.1. would apply to this alternative.

Alternative C

The overall potential for effects to vegetation if Alternative C is implemented would be reduced compared to Alternative A due to the elimination of well pads 46-32 and 18-32 and the access road to well pad 46-32. There would be about 12 acres less area cleared for well pads and access roads under this alternative. As with Alternative A, there would be no effects to special status plant species. Since the two pads that would be eliminated do

have old growth trees, this alternative would reduce effects to old growth trees. Elimination of two exploration wells under Alternative C would slightly reduce the potential for effects to vegetation due to deposition of geothermal fluids during the testing period. Mitigation measure 4.5.1. would apply to this alternative.

Alternative D

There would be no effects to vegetation from implementation of Alternative D, and no mitigation would be required.

WILDLIFE EFFECTS OF ALTERNATIVE A

4.5.5. Wildlife Habitat

Development of the well pad sites and the new access roads would result in the loss of up to 29.6 acres of wildlife habitat. In addition, about 8,150 linear feet of existing access road would require improvement. Improvements would range from minor widening of well-established roads to vegetation clearance within road corridors that have re-emergent vegetation.

Given the limited acreage that would be disturbed by the proposed action and the large area of wildlife habitat that exists in the vicinity of the proposed action, habitat removal at the well pads and access roads would not be expected to have an adverse effect on general wildlife habitat. Since well pads and access roads are generally located on or in the proximity of previously disturbed areas and in areas that are currently used for dispersed recreational uses (with the associated human presence), these pads and roads are considered to be of relatively low habitat value to general wildlife species in comparison to nearby lesser-disturbed areas in the Modoc National Forest.

No new roads are proposed for areas that are critical to animal migration, and the new roads that would be developed would not be expected to serve as an insurmountable barrier to any animal movements. At the end of the life span of the proposed action, reclamation of appropriate well pads and access roads would return disturbed areas to use as wildlife habitat.

During project construction, drilling, and well testing, some animals may avoid habitats in the vicinity of the proposed action due to the presence of humans and increased noise levels (for a discussion of noise effects on animal species, see 4.7.5 in Section 4.7, Noise). However, since proposed activities would be sporadic and temporary in nature, any avoidance of habitats in the vicinity of the proposed action by general wildlife species would also be temporary. In addition, lighting for drilling facilities would be placed so as to not shine directly into surrounding habitats in order to minimize any disturbance of wildlife in the area.

CEGC would construct fences along the perimeter of the well pads, which would minimize the potential for wildlife to pass through the well pad sites and potentially be injured or affected by on-site activities. The material for this fencing would be a flexible

plastic, and would be a visually non-obtrusive color such as green or brown. The fencing would also prevent animals such as deer from drinking from the sumps at the exploration pads. Although sump contents would not be non-hazardous, it would be necessary to prevent animals from drinking from the sumps since the presence of animals on the well sites would increase the potential for injury to these animals.

4.5.6. Northern Spotted Owl

Well pads 18-32 and 46-32 (and the access road to pad 46-32) contain suitable habitat for the northern spotted owl. In addition, suitable habitat for the owl exists throughout the vicinity of the proposed action. However, no owls were observed during the habitat assessment for the proposed action (Wildlife Dynamics 1994). In addition, no northern spotted owls were observed during other recent surveys in the vicinity of the proposed action, and the project vicinity does not appear to be occupied by spotted owls on a regular basis (Gutiérrez 1993; Galea 1994).

Although construction of well pads 18-32 and 46-32 and the access road to pad 46-32 would eliminate the trees at these sites from use as potential habitat for the northern spotted owl, this tree removal would not be expected to adversely affect this species. The total acreage affected by development of these sites would be an extremely small portion of the existing suitable habitat for the owl. There are no known owl breeding pairs or populations that use these sites, and there are no known owl home ranges that include these well pads and access roads. Implementation of the POO would therefore not affect any owl breeding pairs or populations. The well pads and access road contain old growth trees, but are not pure old growth stands. Since the northern spotted owl prefers old growth stands, the development of the pads and road would not affect the preferred habitat of the owl.

Although there are indications that no owls exist within the vicinity of the proposed action, the survey protocol for northern spotted owl requires that six visits be made over a 2-year period, with three visits per year. To date, only the first year of surveys for northern spotted owl have been completed (Galea 1994). The first-year survey included all of the proposed well pad and access road locations except for pad sites 63-20TCH and 15-15TCH (see Figure 1.1-2). The second year of surveys to fulfill protocol requirements for all pads and access roads except 63-20TCH and 15-15TCH will be completed during May 1995 (Ratcliff 1995; Galea 1995).

4.5.7. Northern Goshawk

Well pad 42-13TCH and all of the exploration well pads contain at least marginally suitable habitat for the northern goshawk. No goshawks were observed during the habitat assessment for the proposed action (Wildlife Dynamics 1994). Goshawks have been observed during other recent surveys in the vicinity of the proposed action (not at the well pads or access roads), but these goshawks appeared to just be passing through the vicinity; goshawks are not known to nest in the vicinity (Galea 1994).

Implementation of the proposed POO would reduce the amount of available habitat for the northern goshawk; however, the species would not be expected to be adversely affected by the proposed action due to the limited amount of disturbance. Since there are no known nests or breeding pairs in the vicinity, development of the well pads and associated roads would not be expected to affect the nesting of this species. The relatively small acreage of habitat that would be affected by development of these sites would be an extremely small portion of the existing habitat for the goshawk. The old growth trees that exist at some of the well pad sites are not pure old growth stands that would be considered preferred habitat for the goshawk.

Since goshawk move their nesting sites from year to year, surveys are generally valid only for the year in which they are conducted, and two consecutive years of surveys are recommended to confirm non-occupancy. The 1994 goshawk survey (Galea 1994) included all of the proposed well pad and access road locations except for pad sites 63-20TCH and 15-15TCH (see Figure 1.1-2); the results of the 1994 survey indicate that the surveyed area is not occupied by goshawk. In order to confirm these results and ensure no nests have been established within the project area, a goshawk survey is necessary during the 1995 nesting period (March 1 through July 15) for all pads and access roads except 63-20TCH and 15-15TCH. Goshawk protocol requires a second survey during the post-fledgling dependency period (early July through late August). However, if no nests are found and no responses are recorded during the nesting period survey, a second survey is not necessary (Ratcliff 1995). Completion of these surveys would fulfill goshawk protocol requirements for all pads and access roads except 63-20TCH and 15-15TCH.

4.5.8. Pileated and Other Woodpeckers

No woodpeckers were observed at any of the well pads or access roads during the habitat assessment for the proposed action (Wildlife Dynamics 1994). Well pads 18-32, 46-32, 56-18, and 42-13TCH provide at least marginally suitable habitat for the pileated woodpecker and other woodpeckers. The relatively small acreage of habitat that would be affected by development of these sites would be an extremely small portion of the existing woodpecker habitat. In addition, the well pads and access roads are not known to be regularly inhabited by woodpeckers. The species would therefore not be expected to be adversely affected by the proposed action.

4.5.9. American Marten

No marten were observed at any of the well pads or access road during the habitat assessment for the proposed action (Wildlife Dynamics 1994). All of the proposed well pads and access roads provide some form of habitat for the American marten. The effect of the proposed project would be to reduce the amount of area that could be used as habitat by the species. Given the limited acreage that would be affected by the proposed action, the reduction in potential habitat for the marten would not be expected to significantly affect populations or the range of this species. However, mitigation would be required for the removal of marten habitat.

4.5.10. Mule Deer

All of the proposed well pads and access roads would be within the summer range of the mule deer, and most of the sites provide at least marginal cover or foraging habitat. However, no mule deer were observed at any of the well pads or access roads during the habitat assessment for the proposed action (Wildlife Dynamics 1994). The effect of the proposed project would be to reduce the amount of area that could be used as habitat by the species. Given the wide-ranging nature of the mule deer, the limited acreage that would be affected by the proposed action, and the fact that the proposed action would not present significant barriers to migration or movement, implementation of the proposed POO would not significantly affect populations or the range of this species.

4.5.11. Other Species of Concern

Other species identified as species of concern by the USFS for the proposed action would not be adversely affected by implementation of the proposed POO. None of these species were observed at the well pads or access roads during the habitat assessment for the proposed action (Wildlife Dynamics 1994). Suitable habitat does not exist at any of the proposed well pad sites or access road corridors for the willow flycatcher or the Pacific western big-eared bat.

Only three well pads and associated roads (pads 18-32, 46-32, and 56-18) have the potential to contain necessary habitat components (i.e., large snags with thick, loose, and flaky bark) for the Myotis and Yuma Matist bats. However, potential removal of habitat components at these pads through implementation of the proposed action would represent an extremely small portion of suitable bat habitat in the vicinty. In addition, CEGC would resurvey the well pads prior to any construction activities at these pads to ensure that the pads are not occupied by Myotis or Yuma Matist bats and to identify any suitable habitat components. If suitable habitat components are identified at the pads, CEGC would avoid affecting these components where feasible by avoiding the components, slightly shifting the well pads, providing compensation, or implementing other measures specified by the USFS.

There has been one nesting bald eagle pair identified in the Bald Eagle Management Area (BEMA) at Medicine Lake. This pair has been known to occupy areas on the southern shore of the lake. Although wells 11-24TCH and 15-15TCH and associated access roads would be located either within or in close proximity to the BEMA, these wells would be located on the southern periphery of the BEMA in areas that are not known to be frequented by the nesting pair. In addition, 11-24TCH and 15-15TCH and associated access roads are not considered to be suitable habitat for this species.

MITIGATION MEASURES

Species-Specific Mitigation

Mitigation Measure 4.5.2.

For the northern spotted owl, seasonal restrictions will be imposed by the USFS for all proposed well pad and access road locations. Under these restrictions, no construction or

drilling may take place at the well pads between February 1 and August 15. For all well pads except for pad sites 63-20TCH and 15-15TCH, seasonal restrictions will be imposed until completion of protocol requirements (i.e., the second-year surveys). The second-year surveys will consist of site visits during the appropriate survey period. Upon completion of the surveys, one of two actions will be taken depending on the results of the surveys. If there are no owl responses, it will be determined that the proposed action would not have an effect on the owl, and the USFS will release the well pads from seasonal restrictions for owls. If there are owl responses, the USFS will require the seasonal restrictions as mitigation, and these restrictions will remain in place for those well pads that are in the vicinity of the responses.

The seasonal restrictions for pad sites 63-20TCH and 15-15TCH will remain in place for the life of the proposed action or until northern spotted owl protocol requirements are completed for these pads.

Mitigation Measure 4.5.3.

For the northern goshawk, seasonal restrictions will be imposed by the USFS for all proposed well pad and access road locations. Under these restrictions, no construction or drilling may take place at the well pads between February 1 and August 15. For all well pads except for pad sites 63-20TCH and 15-15TCH, seasonal restrictions will be imposed until completion of protocol requirements The goshawk surveys will consist of nesting surveys in May 1995. Upon completion of these surveys, one of two actions will be taken depending on the results of the surveys. If no goshawks or active goshawk nests are identified, it will be determined that the proposed action would not have an effect on the goshawk, the USFS will release the well pads from seasonal restrictions for goshawk, and the protocol would be deemed complete. If there are goshawk or active goshawk nests, the USFS will require that the seasonal restrictions be left in place until completion of the post-fledgling dependency period survey in early July through late August.

The results of the second surveys (if needed) will again result in one of two actions being taken. If there is no response during the second survey, it will be determined that the proposed action would not have an effect on the goshawk, and the seasonal restrictions for goshawk will be lifted. If goshawk presence is confirmed during the second survey, the USFS will require as mitigation that the seasonal restrictions remain in place for those well pads that are in the vicinity of the responses to avoid effects to goshawk.

The seasonal restrictions for pad sites 63-20TCH and 15-15TCH will remain in place for the life of the proposed action or until northern goshawk protocol requirements are completed for these pads.

Mitigation Measure 4.5.4.

For the American marten, CEGC will provide compensation mitigation for removal of marten habitat. Compensation mitigation will consist of placing d/d material from the well pads in concentrated debris piles near but somewhat isolated from the well pads, which will create denning sites for the marten. One to two piles per acre of disturbed

marten habitat will be provided. Approximate minimum dimensions of the piles will be eight feet wide by four feet tall by 10 feet deep. The extent of compensation and the locations of mitigation sites will be determined by field surveys conducted by the USFS and CEGC prior to any construction activities at well pads.

General Mitigation

Although the proposed action would not be expected to result in significant adverse effects to wildlife in general, the following mitigation measures are recommended to reduce potential effects to wildlife habitats during construction and operation of the proposed action.

Mitigation Measure 4.5.5.

Construction materials and equipment will arrive and leave all well pad sites by way of existing roads or through existing disturbed areas. Construction materials and equipment will not be allowed to cross areas that are to remain undisturbed. Construction materials and equipment will be stored within disturbed areas either at or near the well pad sites.

Mitigation Measure 4.5.6.

Where feasible, CEGC will top existing snags in adjacent areas to make these snags more suitable for use by wildlife species.

WILDLIFE EFFECTS OF ALTERNATIVES B, C, AND D

Alternative B

The overall potential for effects to wildlife would be reduced slightly under Alternative B compared to Alternative A due to the elimination of well pads 42-13TCH and 15-15TCH. There would be about 0.28 acres less area cleared for well pads under this alternative, which would reduce the loss to general wildlife habitat. Compared with Alternative A, Alternative B would have slightly reduced potential for effects to habitat for the northern goshawk, woodpeckers, the American marten, and mule deer. The alternative would not reduce potential effects to northern spotted owl habitat compared to Alternative A. Additional surveys for northern spotted owl and northern goshawk would still be required under this alternative to complete the survey protocol for these species. All wildlife mitigation measures would apply to this alternative.

Alternative C

The overall potential for effects to wildlife if Alternative C is implemented would be reduced compared to Alternative A due to the elimination of well pads 46-32 and 18-32 and the access road to well pad 46-32. There would be about 12 acres less area cleared for well pads and access roads under this alternative. Compared with Alternative A, Alternative C would slightly reduce potential effects to northern spotted owl habitat by eliminating clearing of some old growth trees, although spotted owls are not known to use those trees. Alternative C would have slightly reduced potential to affect habitat for the

northern goshawk, woodpeckers, the American marten, and mule deer. Additional surveys for northern spotted owl and northern goshawk would still be required under this alternative to complete the survey protocol for these species. All wildlife mitigation measures would apply to this alternative.

Alternative D

There would be no effects to wildlife from implementation of Alternative D, and no mitigation would be required.

4.6 Air Quality

SIGNIFICANCE CRITERIA

Federal and state ambient air quality standards have been established for criteria air pollutants (see Table 3.6-1). If emissions from a proposed action would exceed these standards, the action would be considered to have a significant effect. Emissions from a proposed action that significantly affect a Class I area would also be considered a significant effect.

Appendices G and I of the CEQA Guidelines indicate that a project could have a significant effect on the environment if it:

- Results in substantial air emissions or deterioration of ambient air quality
- Contributes substantially to an existing or projected air quality violation
- Exposes sensitive receptors to substantial pollutant concentrations
- Creates objectionable odors
- Alters air movement, moisture, temperature, or the local or regional climate

EFFECTS OF ALTERNATIVE A

4.6.1. Air Emissions During Construction Activities

The primary criteria air pollutant of concern during construction of the proposed action (i.e., grading of well pads and roads and construction-related vehicle travel) would be particulate matter in the form of fugitive dust. Emissions would primarily be caused by construction vehicles and equipment "kicking up" dust in the area. Wind erosion is not expected to occur due to the surrounding trees that serve as wind breaks and the relatively compacted surfaces of the roads and well pads (which have generally been sited on previous disturbed areas).

Air quality effects from construction activities at the well pads and access roads would be localized and temporary. Construction activities would increase particulate matter concentrations in the vicinity of each well pad (lasting one to two days for TCH pads, and about two weeks for exploration pads). These increases would be localized and short-term, and would not be expected to be significant. Because of the low background concentrations of particulate matter in the vicinity of the proposed action and the limited nature of construction activities, these activities would not result in exceedances of the

state or Federal AAQS. In addition, CEGC proposes to reduce dust generation by watering construction areas as necessary. Watering would minimize the localized increases in particulate matter concentrations.

Given the limited amount of vehicle use that would occur during construction activities, construction of the proposed action would not result in significant generation of other criteria air pollutants and would not be expected to exceed state or Federal AAQS.

4.6.2. Air Emissions During Drilling and Testing Activities

Criteria air pollutant emissions and geothermal fluid emissions would occur during well drilling and testing (see 4.6.3 for a discussion of hydrogen sulfide emissions). The primary source of criteria air pollutants during drilling would be from equipment and machinery operating at the sites, as well as vehicles associated with the drilling activities. There would be a limited amount of equipment, machinery, and vehicles located at the well sites, and the volume of emissions from these sources would be expected to be low. CEGC would equip all exhaust stacks on diesel and gas-driven equipment and vehicles with mufflers and utilize low-sulfur fuels to minimize air emissions. Drilling of the proposed wells would therefore not generate significant amounts of criteria air pollutants, and pollutant concentrations during drilling would not exceed state or Federal AAQS.

There would be no geothermal emissions from the TCH wells as they will not encounter the resource during drilling. Only exploration wells would have the potential to release geothermal steam to the atmosphere during drilling and testing. Intermittent geothermal steam emissions could occur during the last 15 to 20 days of drilling. Geothermal steam emissions could also occur during initial exploration well testing (which would last from 1 to 3 days) and long-term testing of the well (which would last 30 to 90 days). Two or more exploration wells could be tested at one time. Given the distance between the exploration wells, the emissions from different well pads would not combine. In addition, the steam produced from existing Glass Mountain geothermal wells has very low concentrations of non-condensable gases.

The emissions of criteria air pollutants from testing geothermal wells typically do not result in significant air quality impacts (NWC 1988; USFS et al. 1994). The primary constituent of concern in the geothermal steam is hydrogen sulfide (see the discussion below in 4.6.3). CEGC considers the steam analysis from the Glass Mountain wells to be proprietary (McClain 1994). The steam analysis was reviewed for this analysis. Concentrations of criteria air pollutants from these releases would not exceed state or Federal AAQS.

Pursuant to requirements of the SCAPCD for the proposed action, particulate emissions from operations would be controlled to less than 40% opacity through the use of mufflers, and water injection into the blooie line would be maintained to reduce particulate emissions. For any air drilling at exploration wells, injected water and a cyclone separator/muffler would be used to control particulates. The impacts of well testing will

also be reviewed by the SCAPCD in their review of the CEGC application for an Authority to Construct (ATC) permit for the proposed wells.

Vehicle travel during drilling and testing activities could result in localized and temporary increases in concentrations of fugitive dust, but would not exceed state or Federal AAQS.

4.6.3. Hydrogen Sulfide Emissions During Well Drilling and Testing

The primary emission of concern during well drilling and testing is hydrogen sulfide (H_2S). H_2S is a colorless, noncondensable gas with a characteristic "rotten egg" odor that can pose hazards to human health at sufficient concentrations. The SCAPCD has established a limit of 10 pounds per hour for the release of H_2S from a geothermal well source (Griffin 1994). H_2S can be released from a well during drilling activities and can be vented during testing activities at a well.

The proposed well drilling and testing would not result in releases of H_2S that would exceed standards, result in nuisances, or pose a human health hazard. Previous testing of the Glass Mountain geothermal resource has resulted in emissions of H_2S at a rate of approximately 2.8 pounds per hour (USFS et al. 1994), which is well below the emission threshold established by the SCAPCD. Well drilling and testing under the POO would be expected to result in approximately the same rates of H_2S emissions as previous testing. These emission rates would generate concentrations that would be well below the applicable state standard and that would not result in a potential hazard to human health.

Although there is the potential that H_2S odors would occasionally be detectable in the vicinity of the well pads during testing, it is not expected that these odors would pose a significant nuisance problem. The low emission rates of H_2S would result in low concentrations and odors that would be quickly dispersed and diluted to barely detectable or undetectable levels. Given the distance of the wells to the nearest summer residences and campgrounds at Medicine Lake (over one mile) and the natural topographical barriers between the wells and these areas, well drilling and testing would not generate H_2S odors that would adversely affect these areas.

To further ensure that there would be no H_2S effects from well drilling and testing, CEGC would monitor H_2S emissions from the wells and concentrations in the vicinity of the well sites and submit the results of this monitoring to the SCAPCD for their review. If H_2S emissions or concentrations exceed established limits, the SCAPCD would be authorized through the ATC/PTO permit for the proposed action to stop well drilling or testing activities until the excessive levels are abated. Worker health would be protected because H_2S emissions during drilling and testing would be monitored. The monitors would be equipped with alarms to indicate H_2S concentrations approaching hazardous levels. Respirators would be available at the drill rig. Although exceedances could occur on a short-term basis until the situation is abated, the authority to stop well drilling or testing activities would ensure that H_2S emissions and concentrations would not result in long-term exceedances of H_2S standards.

4.6.4. Class I Areas

In the vicinity of the proposed action, the two areas that comprise the Lava Beds National Wilderness Area are the only Class I areas. Both of these Class I areas are located approximately six miles north of the proposed action in the Lava Beds National Monument. A natural ridge line running east to west forms a barrier between the location of the proposed action and the Class I areas.

Winds in the area generally blow from northwest to southeast, which would prevent emissions from the proposed action from reaching the Class I areas. Winds would need to blow almost due north for project emissions to have the potential to reach the Class I areas. However, even in these conditions, the natural ridge line would block transport of the emissions to the Class I areas, and the variable topography between the proposed action and the Class I areas would further disperse emissions. The primary visibility-reducing emissions are particulates of about 2 microns in size and sulfate. The project emissions of visibility-reducing constituents would be very small and would not be expected to reduce visual range or contrast in the Class I area. The proposed action would therefore not have an adverse effect on Class I areas in the vicinity of the proposed action.

4.6.5. Public Health Effects

Based on previous analyses of the public health effects other geothermal exploration projects (NWC 1988; USFS et al. 1994), the proposed project would not adversely affect public health. The geothermal fluids at Glass Mountain that have been tested thus far show lower levels of contaminants than those at other geothermal fields, and no public health effects are expected.

EFFECTS OF ALTERNATIVES B, C, AND D

Alternative B

The air quality effects of Alternative B, elimination of pads 42-13TCH and 15-15TCH, would be similar to those of the proposed action (Alternative A). Activities at the other eight well pads would be the same as under the proposed action, and would have the same potential to affect air quality. However, there would be no localized dust emissions or increases in criteria air pollutant concentrations at pads 42-13TCH and 15-15TCH. Since these two sites would not be graded, there would be no fugitive dust generation from these sites, and no equipment or machinery would occupy the sites that could emit criteria air pollutants.

If Alternative B is selected, the potential for H_2S odors and health hazards would be the same as the proposed action because there would be no geothermal emissions from the TCH wells. The impacts to the summer residences and campgrounds at Medicine Lake would be the same as those under the proposed action.

Alternative C

The air quality effects of Alternative C, elimination of pads 46-32 and 18-32, would be similar to those of the proposed action (Alternative A). Activities at the other eight well

pads would be the same as under the proposed action, and would have the same potential to affect air quality. However, there would be no localized dust emissions or increases in criteria air pollutant concentrations at pads 46-32 and 18-32. Since these two sites would not be graded, there would be no fugitive dust generation from these sites, and no equipment or machinery would occupy the sites that could emit criteria air pollutants.

If Alternative C is selected, the potential for H_2S odors and health hazards would not occur at or in the vicinity of pads 46-32 and 18-32.

Alternative D

There would be no air quality effects from implementation of Alternative D.

4.7 Noise

SIGNIFICANCE CRITERIA

Federal and state noise regulations provide significance criteria for evaluating estimated noise levels. Federal standards for noise generated from geothermal projects are identified in Part 11.C. of the U.S. Department of Interior's GRO No. 4, which states that, in the absence of more restrictive criteria, noise levels from a geothermal operation at 0.5 miles (approximately 0.8 kilometers or 2,640 feet) or at the lease boundary (whichever is greater) shall not exceed 65 dBA.

According to Appendix G of the CEQA Guidelines, a project would normally have a significant effect on the environment if it would substantially increase the ambient noise levels of adjoining areas. Appendix I of the CEQA Guidelines indicates that a project will have a significant effect if it exposes people to severe noise levels. However, CEQA does not establish quantified thresholds for determining substantial or significant increases in noise levels.

EFFECTS OF ALTERNATIVE A

4.7.1. Pad and Road Construction Noise

Estimated noise levels at various distances from pad and access road construction are shown on Table 4.7-1. Noise from construction activities would be temporary in nature and would occur for very short durations (one to two days at the TCH well sites, and about two weeks at the exploration well sites). In addition, trees and the natural barriers formed by the topography in the vicinity of the proposed action would serve to attenuate (reduce) construction noise levels.

The noise-sensitive receptors closest to the proposed action are the summer residences and campgrounds located near Medicine Lake. These recreational facilities are located approximately one mile from the closest TCH well pad, and about 1.5 miles from the closest exploration well pad. As shown in Table 4.7-1, noise from construction activities at the summer residences and campgrounds would be less than 38 dBA, and well below the 65-dBA standard for geothermal operations. Noise levels experienced at the sensitive

Table 4.7-1: Typical Noise from Geothermal Exploration Activities

Activity	Noise Level (dBA)[1] 100 feet	200 feet	500 feet	1,000 feet	2,000 feet	5,000 feet
Site preparation and construction	78	73	66	58	50	38
Well drilling	75	68	60	53	44	30
Well clean-out	75	68	58	50	41	25
Flow testing	78	73	66	59	52	42

Notes:
[1]Identified noise levels are given for various distances from a proposed noise-generating source. These noise levels do not account for the topographical barriers and trees throughout the project vicinity, both of which absorb or deflect sound waves, thereby reducing noise levels.

SOURCE: CEGC 1994

receptor sites would be expected to be lower than 65 dBA due to the sound-muffling properties of the Forest.

Since construction noise would be temporary and below the 65-dBA standard at the closest receptors, this noise would not be considered to substantially increase the ambient noise levels in the area and would not expose people to severe noise levels. Noise from construction would therefore not adversely affect noise-sensitive receptors in the vicinity.

4.7.2. Traffic Noise

Vehicles associated with construction, drilling, and testing of the well sites would generate intermittent noise throughout the vicinity of the proposed action. Vehicle noise would occur sporadically and would not result in substantial increases in ambient noise levels or expose people to severe noise levels.

4.7.3. Well Drilling Noise

Estimated noise levels at various distances from well drilling activities are shown on Table 4.7-1. All well drilling equipment would be maintained and muffled to ensure compliance with the Federal Occupational Safety and Health Act of 1970 and GRO No. 4. Drilling noise and equipment operations would be limited in duration (approximately 60 to 90 days at each site).

Sound pressure level (SPL) surveys have been conducted to measure the effect of geothermal drilling operations on ambient noise levels at geothermal well sites that are in a noise environment similar to that of the proposed action (Reeder 1986). SPLs were measured at these well sites before and during drilling operations. The results of the SPL surveys give an approximate range within which the noise levels of drilling operations are

measurable, and beyond which these noise levels blend into ambient noise levels found under normal conditions.

Prior to drilling, the ambient SPL at all geothermal well sites was generally recorded at between 20 and 30 dBA, which is typical for a rural area. During drilling, the SPL at the well sites was between 70 and 80 dBA, with a maximum reading of 81 dBA immediately next to the noise source at the well site. At a distance of 1,000 feet from the geothermal well sites, the measured SPL was below 40 dBA during drilling. An SPL of 40 dBA or less is judged to be a quiet environment. At a distance of 0.5 miles from the well sites, measurements made during drilling operations were approximately 28 dBA, or within the normal range of noise levels measured prior to drilling operations (Reeder 1986).

Noise levels from drilling activities under the proposed POO would be expected to be similar to those identified during the SPL surveys. As shown in Table 4.7-1, noise levels from drilling activities would not exceed 65 dBA at the closest receptors and would be in accordance with GRO No. 4. Trees and the natural barriers formed by the topography in the vicinity of the proposed action would serve to attenuate (reduce) well drilling noise levels. Noise levels from drilling would therefore not be considered to substantially increase the ambient noise levels in the area and would not expose people to severe noise levels.

4.7.4. Well Testing Noise

Estimated noise levels at various distances from exploration well testing activities are shown on Table 4.7-1. TCH wells would not be tested as they would not be drilled to reach the geothermal reservoir. Well testing would only occur at exploration wells. The exploration well pad closest to the summer residences and campgrounds near Medicine Lake is pad 13-18, which is located about 1.5 miles from these recreational facilities.

All well testing equipment would be maintained and muffled to ensure compliance with the Federal Occupational Safety and Health Act of 1970 (OSHA) and GRO No. 4. As shown in Table 4.7-1, noise from well testing activities would be expected to be below the 65-dBA standard at the closest noise-sensitive receptors. Ambient noise at the receptors during testing could be in the range of 25 to 35 dBA, which would be similar to the existing noise environment in the vicinity of these receptors. Trees and the natural barriers formed by the topography in the vicinity of the proposed action would serve to attenuate well drilling and testing noise levels. Noise from well testing activities would not expose people to severe noise levels and would not be considered a substantial increase in ambient noise levels. Increases in noise levels would therefore not adversely affect noise-sensitive receptors in the vicinity.

Ambient noise levels in the immediate vicinity of the well pads would be expected to increase during well testing activities. However, these increases in noise levels would only occur during testing and would be temporary in nature. As stated earlier, noise levels from well testing activities are expected to be in compliance with the Federal OSHA and GRO No. 4.

4.7.5. Noise Effects on Animal Species

Estimated noise octave and spectra from geothermal exploration activities are shown on Table 4.7-2. During exploration activities, some animals may avoid habitats in the vicinity of the proposed action due to the increased noise levels, particularly if a species is sensitive to a frequency range that the various geothermal exploration activities would generate. However, since proposed activities would be sporadic and temporary in nature, any avoidance of habitats in the vicinity of the proposed action by general wildlife species would also be temporary.

EFFECTS OF ALTERNATIVES B, C, AND D

Alternative B

The overall noise effects of Alternative B, elimination of pads 42-13TCH and 15-15TCH, would be similar to those of the proposed action (Alternative A). Construction, traffic, drilling, and testing noise would still occur under Alternative B. Although the two TCH well pads would be eliminated, activities at the other eight well pads would be the same as under the proposed action, and would have the same potential to generate noise.

During construction and well drilling, noise levels at the noise-sensitive receptors located near Medicine Lake would be expected to be less since construction and well drilling would not occur at pads 42-13TCH and 15-15TCH under Alternative B. Since no exploration pads would be eliminated under this alternative, noise from well testing would be the same as described for the proposed action.

Table 4.7-2: Estimated Noise Octave and Spectra from Geothermal Exploration Activities[1]

		Octave Band Center Frequency (cps)[2]								
Activity	Distance	31.5	63	125	250	500	1,000	2,000	4,000	8,000
Site preparation and construction	50	82	82	87	85	82	78	75	71	60
Well drilling	150	84	85	86	80	69	68	65	63	63
Well clean-out	150	70	76	84	91	92	92	90	91	82
Flow testing: max	150	74	80	88	95	96	96	94	95	86
min	150	68	75	85	91	91	91	86	86	76

Notes:

[1]Estimated noise spectra is expressed as sound pressure level in dB re 0.0002 microbar; the spectra in this table does not account for the topographical barriers and trees throughout the project vicinity, both of which absorb or deflect sound waves, thereby reducing noise levels.

[2]cps = centimeters per second.

SOURCE: CIEA 1995

Alternative C

The overall noise effects of Alternative C, elimination of exploration well pads 46-32 and 18-32, would be similar to those of the proposed action (Alternative A). Construction, traffic, drilling, and testing noise would still occur under Alternative C. Activities at the other eight well pads would be the same as under the proposed action, and would have the same potential to generate noise. However, the elimination of the two well pads under Alternative C would eliminate noise generation from these sites, and increases in ambient noise levels in the immediate vicinity of these sites would not occur.

Given the distance of pads 46-32 and 18-32 from the noise-sensitive receptors located near Medicine Lake, implementation of Alternative C would not be expected to result in a noticeable difference from the proposed action in noise levels at the receptors during construction and well drilling activities. However, since the elimination of pads 46-32 and 18-32 would eliminate well testing at these pads, noise levels at the receptors near Medicine Lake during well testing activities would be expected to be less under Alternative C.

Alternative D

There would be no noise effects from implementation of Alternative D.

4.8 Visual Resources

SIGNIFICANCE CRITERIA

A project would be considered to have a significant effect if it were not consistent with USFS designated visual quality objectives (VQOs) which provide standards for visual management of Forest lands. In addition, CEQA Guidelines consider that a project would have a significant effect if it would obstruct any scenic vista or view open to the public or create an aesthetically offensive site open to public view.

EFFECTS OF ALTERNATIVE A

4.8.1. Long-Range Views From Surrounding Vantage Points

The proposed action would create both short-term and long-term physical changes to the forest environment that may be visible from vista and vantage points in the surrounding area.

Visual Elements of the Proposed Action: Areas cleared for access roads could create a break in the tree line when viewed from long-range vantage points. However, the forest is characterized by numerous logging roads and the majority of the well pads would be accessed via existing logging roads. Road renovation along these existing roads would require clearing and grading of reemergent vegetation. Removal of this vegetation would not result in noticeable long-range visual contrast compared to existing conditions. New road construction would be required at two well pads: 46-32, and 42-13. However, since new and improved road widths would be only approximately 14 feet wide, the resulting break in the tree line would result in a minimal level of visual contrast from long-range

vantage points. This is especially true since previous logging activity has resulted in a forest canopy characterized by numerous breaks in the tree line. Access roads would therefore be a long-range visual feature of the proposed action that would not create a significant visual impact.

Clearing of vegetation for exploration well pads could create a noticeable break in the tree line when viewed from long-range vantage points. Well pads for TCH wells would require smaller areas of disturbance than exploration well pads, and would result in a lower potential for visual impact. All of the exploration well pads contain some large trees that would need to be cleared; however, all but one of the well pads (46-32) would be constructed in areas that have been previously logged. These areas are characterized by reemergent vegetation and replanted conifers, along with some larger trees. The variation in the height of the trees creates an existing interrupted tree line. Clearing these areas and grading the well pads would result in minimal if any visual impact to long-range views.

During the drilling phase of the proposed action, drill rigs and associated equipment would occupy the well pads. The primary visual feature during this phase would be the tower of the drill rig. Large rigs used for exploration drilling are about 140 feet high and the smaller rigs used for drilling temperature core holes are about 90 feet high. Depending on the size of the trees in the vicinity of the well pads, the tops of the drill rigs may be visible from long-range vantage points, especially for the larger rigs. Rigs would be lighted at night and night lighting could be visible from some vantage points. Exploration rigs would be visible at well pads for a period of 30 to 90 days for each well. Temperature core hole rigs would be visible for 25 to 60 days at each site. Given the short time period that drill rigs could be visible, this would not be considered a significant impact.

Once the well is completed and the drill rig is removed, testing would occur at each exploration well for a period of 30 to 90 days. Temporary facilities would be constructed during the testing phase; the largest piece of equipment would be the atmospheric separator, which is about 30 feet tall. During this period, a steam plume could be visible from surrounding vantage points. Since testing would be expected to occur in the summer months when the air is driest, the height of the plume would range from 40 to 150 feet above the separator. The plume would be largest in the morning when the humidity is highest. From long-range vantage points, the steam plume would be visually subordinate to the surrounding landscape and would not create a significant effect. After completion of testing at exploration well pads, the well(s) could be capped for future use as either a production or injection well, or could be shut in and the well pad reclaimed. This decision would be part of the utilization phase of geothermal development and would be covered under future environmental documents. Until well pads are reclaimed, they could remain slightly visible from long-range vantage points.

Temperature core holes would not be flow-tested, so no large pieces of equipment or atmospheric venting would be required. Testing would therefore not create significant visual effects. After completion of testing at temperature core holes, the well would be shut in. At decommissioning, the well pad would be regraded and revegetated to the extent possible, but reemergent vegetation would not reach full growth for a relatively

long time period. During this period, the well pad would continue to create a visual contrast with the surrounding area. However, given the small size of the TCH well pads, and the previous logging disturbance that exists at the sites, visual contrasts would not be significant.

Vantage Points: The primary long-range vantage points from which project features could be visible are the peaks surrounding the Medicine Lake caldera. These include: Mount Hoffman, Little Mount Hoffman, Medicine Mountain, Glass Mountain, Badger Peak, and Redshale Butte. All of these peaks, with the exception of Little Mount Hoffman, are forested and long-range views are intermittent, with many views obstructed by tree cover. Little Mount Hoffman does not have heavy tree cover and provides unobstructed long-range views of portions of the project area.

Most of the identified vantage points are in unroaded areas, and views from these vantage sites would be experienced only by hikers or other recreational users. At any given time, a maximum of two exploration drill rigs and one temperature core hole rig would be operating. Occasional views of tree breaks or the tops of drill rigs for short periods during drilling would not significantly degrade views from these vantage points. There are no vantage points from which three well pads could be viewed at the same time. Little Mount Hoffman is accessible via a USFS road accessing a lookout station and therefore provides views to a greater number of travelers than any of the unroaded vantage points. However, Little Mount Hoffman is the westernmost vantage point and is two miles from the nearest well pad site. Additionally, all of the well pads except 15-15TCH have topographic obstructions that would obstruct views from Little Mount Hoffman. 15-15TCH may be visible from this vantage point, but it is over two miles away and is a relatively small TCH pad located in a logged area. Views from Little Mount Hoffman would not be noticeably altered by any of the short- or long-term features of the proposed action.

The residences on the east side and campgrounds on the northern edge of Medicine Lake are located in the lowest topographic portion of the Medicine Lake caldera. The proposed access roads and well pads would be located at higher elevations, or would be screened by topographic features; therefore, none of the project features would be visible from the Medicine Lake area.

4.8.2. Short-Range Views

The same elements of the proposed action that could be visible from long-range vantage points could also be visible from short-range viewing points and routes of travel.

The primary travel routes in the project area are Primary Forest Route (PFR) 97 and Forest Roads 43N48 and 44N75. There are several additional Forest Roads in the area, none of which is heavily trafficked. Three temperature core hole pads, 34-8TCH, 42-13TCH, and 11-24TCH, would be located relatively close to forest roads. However, the potential for visual impacts at these sites would be minimized by relatively small size of the pads and the screen of trees that would be left between the road and the well pad. Exploration well pad 56-18 is close to PFR 97. At this location, the drilling rig may be visible to travelers

during the 90-day drilling period. All other pads would be located far enough from roads that they would not be visible from the roads.

All of the well pads and drilling and testing equipment would be occasionally visible to hikers and other recreational users in the immediate vicinity of the well pad. However, the main visible component of the proposed action, the drill rig, would be at the site for a short time period and would therefore not significantly affect views. After testing, the main feature in short-range views of the well pad would be a flat clearing. Visibility of the well pads and drilling rigs from short-range views would not result in significant visual effects.

4.8.3. Consistency With VQOs

Table 3.8-1 shows the VQO designations for the proposed well pad sites. None of the proposed well pad sites are designated for Preservation, the strictest designation.

Retention: Two exploration well pad sites, 18-32 and 56-18, are located in areas with a VQO designation of Retention (see Table 3.8-1). Under this designation, project activities may occur, but should not be visually evident to the casual observer. The designation specifies that efforts to reduce visual contrast should be accomplished during project operation or immediately thereafter.

Well pads 18-32 and 56-18 are located away from roadways and would not be visible to the casual observer. The temporary nature of the drilling operation would be consistent with an effort to reduce visual contrast immediately, as would the revegetation of the well pads that would occur upon completion of the project. The proposed action would therefore be consistent with the objectives for this designation.

Partial Retention: Four temperature core hole sites, 42-13TCH, 11-24TCH, 63-20TCH, and 15-15TCH, and two exploration well pads, 46-32 and 13-18, are located in areas designated Partial Retention. Under this designation, project activities should remain visually subordinate to the characteristic landscape, but may introduce some contrasting visual elements to the landscape. The designation specifies that efforts to reduce visual contrast should be accomplished as soon as possible after project completion or within the first year.

The clearing of well pads 42-13TCH, 11-24TCH, 63-20TCH, 15-15TCH, 46-32, and 13-18 would not introduce a dominant feature to the characteristic landscape. The temporary nature of the drilling operations at the well pads would be consistent with the objectives of this designation, as would the revegetation of the well pads that would occur upon completion of the project.

Modification: One temperature core hole site, 34-8TCH, and one exploration well pad, 58-6, have VQO designations of Modification. Under this designation, project activities may dominate the landscape; however, project activities should retain visual elements of

the surrounding area to the extent possible. The designation specifies that efforts to reduce visual contrast should be accomplished within the first year following project completion.

Well pads 34-8TCH and 58-6 would be the main long-term feature of the proposed action and would not be dominant features in the characteristic landscape. In addition, the temporary nature of the drilling operation would be consistent with the objective of reducing visual contrast as soon as possible, as would the revegetation of the well pads that would occur upon completion of the project.

EFFECTS OF ALTERNATIVES B, C, AND D

Alternative B

The overall visual impacts of Alternative B, elimination of pads 42-13TCH and 15-15TCH would be slightly reduced compared to the proposed action (Alternative A). This alternative would be consistent with VQOs designations. The two TCH pads eliminated under this alternative would be potentially visible from Little Mount Hoffman. This alternative would therefore slightly reduce potential long-range views from this vantage point. Elimination of the two well sites would also slightly reduce potential short range visual effects.

Alternative C

The overall visual impacts of Alternative C, elimination of pads 46-32 and 18-32, would be slightly reduced compared to the proposed action (Alternative A). This alternative would be consistent with VQOs designations and would eliminate one well pad with the Retention designation (18-32). Elimination of the two exploration well pads would eliminate the potential for the temporary visual impact of the drill rig being seen above the tree line during the drilling process. The two well pads that would be eliminated are away from routes of travel and would not be expected to be visible in short-range views. Potential reductions in short-range visual effects would therefore be minimal.

Alternative D

There would be no visual impacts from implementation of Alternative D.

4.9 Land Use, Recreation, and Transportation Systems

SIGNIFICANCE CRITERIA

A proposed action may have a significant effect on the environment if it would not be compatible with existing land uses of an area or cause an actual physical change to the environment as a result of a conflict with adopted environmental plans and goals for the area in which it is located (in this case, the Modoc National Forest). In addition, according to the CEQA Guidelines, a proposed action may have a significant effect on the environment if it would:

- Disrupt or divide the physical arrangement of an established community

- Conflict with established recreational, educational, religious, or scientific uses in an area
- Result in a substantial alteration of the present or planned land use of an area

A proposed action that would cause an increase in traffic that is substantial in relation to the existing volumes and capacity of the road network would be considered to have a significant adverse effect. In addition, the USFS considers destruction of existing roadways in the Modoc National Forest by heavy truck use to be a significant adverse effect.

EFFECTS OF ALTERNATIVE A

4.9.1. Existing Land Uses

The proposed action would not be expected to conflict with existing land uses in the vicinity. Development of the TCH and exploration well pads would be a continuation of the existing geothermal exploration that has occurred in the vicinity of Medicine Lake over the last 15 years. The new access roads that would be develop in the area would be a continuation of the existing road network development that currently exists in the area. Access roads would be gated to control access by unauthorized persons. The proposed action would not be expected to conflict with Native American uses in the vicinity (see 4.3.3 in Section 4.3, Cultural Resources).

The proposed action would occupy a relatively small area (approximately 29.6 acres) within the Modoc National Forest. Since the well pads would be dispersed throughout the vicinity of the proposed action, there would not be an excessive concentration of development at any one location. The proposed action would therefore not be considered to represent a substantial alteration of the present land uses in the area.

Noise generated by implementation of the proposed action would not be expected to adversely affect other land uses in the vicinity (see Section 4.7, Noise). In addition, the proposed action would not be expected to emit H_2S odors that would adversely affect other land uses (see Section 4.6, Air Quality), and would not be expected to result in adverse visual effects (see Section 4.8, Visual Resources). A discussion of the compatibility of the proposed action with recreational uses in the vicinity is discussed in 4.9.4, Recreation.

4.9.2. Consistency with Plans

Lease Stipulations: The proposed action would be would be consistent with the lease stipulations for Federal Geothermal Leases CA-12367, CA-12370, CA-12371, CA-12372, CA-1224, and CA-2500. Only one well pad (pad 42-13TCH on lease CA-12371) is located within a no surface occupancy lease stipulation area. This stipulation prohibits occupancy of the specified portion of the lease area if the proposed POO would result in significant adverse impacts related to recreational uses. As discussed in this section under 4.9.4., Recreation, implementation of the proposed POO would be a short-term temporary effect that would not significantly effect recreational uses in the area. Development of well pad 42-13TCH would therefore not have a significant adverse impact on recreational uses, and

would therefore not conflict with the no surface occupancy lease stipulations carried by CA-12371. No activities are proposed under the POO for any other portions of the leases that carry a no surface occupancy lease stipulation.

Modoc National Forest Plans: The proposed action would be consistent with the policies and management direction contained in the USFS *Modoc National Forest Land and Resource Management Plan* (USFS 1991a). The Plan identifies standards and guidelines for the Forest. The proposed action would be consistent with Guideline 10.1, which encourages exploration of mineral resources. The standards and guidelines in the Plan specifically for the Medicine Lake area state that geothermal development should not be precluded by other management activities, and that habitat for the marten should be maintained during geothermal exploration activities.

President Plan: The proposed action would not conflict with the President Plan, which provides standards and guidelines for the management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl (this document is also known as "Option 9" due to the selection of the Option 9 Alternative as the preferred alternative) (USFS and BLM 1994b). The project area is located in a matrix area (i.e., outside of designated late-successional reserves and other old growth management areas) on the extreme eastern edge of the range of the spotted owl, on the edge of the "CA Cascade" physiographic province, as delineated in the President Plan. The proposed action would be consistent with standards and guidelines for matrix areas, including providing a supply of coarse woody debris (i.e., d/d logs) and avoiding the fragmentation of old growth stands in areas where few old growth stands remain.

In addition to providing standards and guidelines, the Option 9 document specifies that three late-successional territories be delineated in the Medicine Lake area. These territories are currently being delineated by the USFS, and proposed territories have been identified. One of the proposed late-successional territories is in the vicinity of Medicine Mountain, and includes one of the proposed TCH well pads (11-24TCH). Since these well pads are located on previously disturbed areas and development of these well pads would not require the clearance of late-successional or old-growth vegetation, implementation of the proposed action would be consistent with the Option 9 document.

4.9.3. Mount Hoffman Roadless Release Area

Within the 10,800-acre Mount Hoffman Roadless Release Area (RRA), two well pads (18-32 and 46-32) and a 2,200-foot road to well pad 46-32 would be constructed. These facilities would occupy about 12 acres within the RRA. The 12 acres would represent approximately 0.1% of the total acreage of the RRA in a relatively confined area near the perimeter of the RRA. Given the location and relatively small size of these well pads and road, development of these facilities would not affect the future consideration of this area as a Federal Wilderness Area.

Section 20.6.3 of the USFS *Environmental Policy and Procedures Handbook* (USFS 1992) states that proposals that would substantially alter the undeveloped character of an inventoried