4: ENVIRONMENTAL CONSEQUENCES

4.1 Introduction

This section of the EA/IS provides an analysis of expected environmental effects of the proposed action and alternatives. For each effect, the level of significance is discussed and mitigation proposed to reduce any effects. Significance criteria are determined by the lead agency. The CEQA Initial Study Checklist for this project is located in Appendix F.

The critical elements of the human environment have been addressed throughout this document. The proposed project will not affect certain critical elements because they do not exist in the project area. The project will not affect:

- Areas of Critical Environmental Concern
- Prime or unique farmlands
- Floodplains
- Wetlands or riparian areas
- Wild and scenic rivers
- Wilderness areas

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

IMPACT OVERVIEW

Geothermal systems are typically located in active geologic settings with recent or active faulting and/or volcanism and/or seismicity. These active geologic processes can present potential geologic hazards. In addition, soils derived from relatively recent volcanic rock material are typically not well developed and therefore construction may impact surface materials. Although large geothermal developments elsewhere in the world have produced some geological impacts related to the extent of the development such as micro-seismic activity and subsidence, these impacts are related to development activities (rather than exploration drilling and testing). In addition to the fact that the Glass Mountain geologic setting is not conducive to these impacts, the proposed exploration project is limited in duration and is not expected to induce geologic hazards.

EFFECTS OF ALTERNATIVE A

Geologic Hazards

To minimize potential effects from geologic hazards and erosion, Best Management Practices (BMPs) would be employed during construction and maintenance of all project drill sites and access roads. All site grading would balance cut and fill to the extent practical to minimize potential effects from erosion and geologic hazards. All construction vehicles, project traffic, and worker parking would be confined to designated roadways and drill sites to minimize adverse effects on undeveloped areas. All improved and constructed access roads and drill sites would be maintained until the respective drill sites are abandoned and site reclamation actions are initiated.

Slope Stability. All of the proposed project facilities would be located in areas of gentle to moderate slopes of under 10% and in areas of stable soil types. The proposed action would therefore not cause or be affected by unstable soils or slopes.

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

Minerals

There are no known commercial deposits of precious, strategic, or base metals in the project area. 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 or affect areas of known surface or subsurface mineral resources. The proposed action would therefore not prevent the recovery of any mineral resources.

Unique Geologic Features

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 buffer would be adequate to avoid affecting this unique geological feature.

Erosion

The proposed action would result in minor increases in soil erosion rates through grading and other construction activities for well sites 64-27 and 85-33. These changes would be adverse, but not significant. Decommissioning activities could result in minor, short-term increases in erosion for these two sites. No increases in erosion would occur at the flowtest sites (87-13, 31-17 and 68-8).

Although grading for construction of well pads and the widening of roads has the potential to increase erosion, CPN would prevent erosion through the use of careful site preparation procedures. All site grading would balance cut and fill to the extent practical to minimize potential effects from erosion. Standard construction techniques for control of runoff from construction sites would be employed, and construction would be designed to avoid changing existing drainage channels.

For road widening, erosion would be controlled by Best Management Practices (BMPs). Water bars, outslope roads, road ditches, and rock drainages would be used for erosion control along roads. Upon completion of the project, should CPN determine that a viable geothermal resource does not exist, and elects not to pursue further exploration or development activities, 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. If the exploration is successful, the road would continue to be used and maintained according to USFS requirements in the CPN road use permit. Construction and use of roads would therefore not significantly increase the potential for erosion.

In general, erosion potential in the project area is relatively low because the high porosity of soils reduces runoff potential.

Additionally, a storm water pollution prevention plan was submitted to the Regional Water Quality Control Board prior to start of construction activities.

Seismicity

The proposed action would not cause an increase in seismicity in the area. Induced microseismicity has been related to injection of geothermal fluids in The Geysers, a steam dominated reservoir. The proposed action would involve the injection of geothermal

fluids under pressure, which is a function of the injectivity of the reservoir. However, there would be limited volumes of geothermal fluids produced and returned to the reservoir at whatever pressures are required to put the fluids back into the geothermal reservoir. Ground shaking associated with a seismic event in the region has the potential to damage well casings. Applicable GROs are designed with seismic conditions in mind. The implementation of the GROs would serve to mitigate potential affects from subsurface shaking. 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 not be exposed to an excess level of hazard during drilling or testing operations.

Volcanism

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 and be-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 mudflows are ejected from a volcano, they pick up more water as they melt snow, slide through lakes, and eventually flow down existing drainages. Mud flows occurring as a result of an eruption in the Highlands would not be extensive because few drainages exist in the area.

Liquefaction

The soils in the region are coarse, well drained, rarely saturated, and not considered to be susceptible to liquefaction. In addition, should a natural earthquake occur, it is unlikely to be of sufficient magnitude to induce liquefaction.

Topography

The proposed action would involve grading of:

- One TGH well pad measuring approximately 75 feet by 150 feet with later expansion to an exploration well pad measuring approximately 360 feet by 360 feet (CPN 2002)
- One exploration well pads measuring approximately 360 feet by 360 feet from an existing TGH well pad of measuring approximately 75 feet by 100 feet (CPN 2002)

Total potential graded land area is approximately six acres.

To the greatest extent possible, the proposed deep exploration well pads have 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.

Road improvements would be limited to the minimum width requirements for single lane traffic and will meet USFS standard construction requirements (CPN 2002).

At the end of the life span of the proposed action, the exploration well pads would either be recontoured to pre-project conditions and reseeded as appropriate and in conformance with USFS site restoration requirements (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 CPN decides to pursue development and utilization of the resource). An analysis of continued use of selected wells 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.

MITIGATION MEASURES

CPN has proposed a number of measures as part of the plan of operations, which would result in less than significant impacts, related to geology and soils. These are described above. No additional measures are needed to reduce effects to less than significant levels.

EFFECTS OF ALTERNATIVE B

Alternative B

No adverse effects on geologic resources would result from Alternative B, the "No Action" alternative.

4.3 Hydrology and Geothermal Resources

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

METHODOLOGY

Activities associated with the proposed action were evaluated to assess their impacts to surface water and groundwater resources. Water use was estimated and compared to estimates of the amount of available groundwater and surface water and the rate of groundwater and surface water recharge. The potential for degradation of surface water or groundwater quality as a result of proposed action spills, releases, fluid production, injection, and air emissions was also evaluated.

IMPACT OVERVIEW

The proposed project design and applicable regulations define measures to protect surface water and groundwater quality. Groundwater would be protected by the implementation of the drilling and casing program. There is no surface water in the immediate vicinity of the proposed project areas (Medicine Lake is at least 1.5 miles from the closest well site). CPN contingency plans would limit the potential for spills of hazardous materials and geothermal fluids.

Using only previously permitted water sources, preventing the uncontrolled release of fluids and hazardous materials, and controlling the production of geothermal fluids would avoid potential impacts to surface and groundwater. Natural hydrologic barriers exist between the surface, groundwater, and the geothermal system and are anticipated to prevent any potential effects of geothermal drilling and testing on shallower groundwater resources.

CPN has also developed a set of guidelines for minimizing the effects of drilling, spills, and related accidental releases to the surface or subsurface including:

- Blowout Contingency Plan
- Accident and Injury Contingency Plan
- Spill Response Plan

These plans are included in Appendix E, The 2002 CPN Telephone Flat POO/POE. The plans include mitigation measures such as cementing casing through groundwater and perched water zones, using environmentally benign drilling fluids such as bentonite mud

as necessary, using aerated mud within the reservoir, rapid containment, reporting, and clean-up of leaks or spills. These guidelines and drilling programs comply with GRO Order No. 2.

EFFECTS OF ALTERNATIVE A

Water Use

The drilling operation proposed for this project would consume an average of approximately 200 barrels[1] per day of water for drilling and dust abatement over the 45-day drilling period for each well. This equates to approximately 9000 barrels for a 45-day well. The proposed project includes drilling two deep exploration wells. 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. In addition, a lesser amount of water would be used for dust abatement during the six to eight weeks of well pad and road construction.

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 (1-2 weeks for the TGH well, and 30-days for each exploration well). Water for the proposed action would either be trucked in or piped to the well pad sites from an existing CPN water well in Arnica Sink. Similar amounts of water were withdrawn to drill the existing geothermal wells. These water withdrawals did not have a significant effect on water availability in Arnica Sink. The proposed water withdrawals would not have a significant effect on water availability.

The pipeline that would be used for flow testing site 88A-28 (previously permitted well) would be used to flow test the wells at site 85-33 and site 64-27. Water would be trucked to site 64-27 during the drilling of the TGH. A pipeline would be laid from site 88-28 to site 64-27 along Forest Route 49 should a deep well be drilled. It is also possible that one of the hydrologic monitoring wells required under the Fourmile Hill development plan would be drilled at site 88-28 to be used for water during drilling operations once the resource is confirmed. This would allow the removal of the pipeline through Arnica Sink to that water well. Tanks would be on-site to hold water for all drilling operations.

Water Quality

Hazardous materials and wastes would be managed in accordance with California state laws and appropriate federal regulations. Drilling cuttings would be stored in the sump during drilling. The sumps would be lined with a 1-foot layer of clay, meeting at least a 10^{-6} cm/sec permeability to meet RWQCB requirements. If during drilling or testing the sump begins to approach capacity, then either the flow would be reduced or discontinued, or the fluids may be piped to another location. If required, appropriate permits for off-site transportation of drilling fluids or other drilling wastes would be obtained from appropriate agencies.

After drilling and testing are completed or if solids need to be removed from the sump prior to the completion of testing, the waste would be sampled and analyzed. Based on the analytical results, the drilling cuttings would be disposed of in accordance with the

[1] 1 barrel=42 gallons

California environmental requirements at an appropriate disposal facility (see 4.12 Health and Safety for additional information on wastes).

Groundwater. No impacts to groundwater are anticipated from drilling, well leaks, or spills. No impacts to groundwater quality from surface spills are anticipated due to protection by:

- Clay liners in sumps
- Appropriate spill minimization procedures included in the POO
- The depth to the deep piezometric groundwater surface (800 to 2000 feet bgs)

Potential subsurface impacts to groundwater quality are also minimized during drilling by:

- Drilling and casing programs prescribed by the GROs
- Proper placement of casing and cementing of casings to seal off shallow aquifers
- Compliance with the applicable regulations of the RWQCB.

Personnel on site would use portable chemical sanitary facilities. The chemical sanitary facilities would be maintained and wastes disposed of by a local contractor.

Surface Water. Surface water quality could potentially be affected if runoff, drilling fluids, or geothermal fluids were allowed to enter the surface drainage systems in the vicinity of the proposed action sites. The proposed well sites in the Fourmile Hill area are located on the outer rim of the Medicine Lake Volcanic basin. The Telephone Flat sites are located within the Caldera. Medicine Lake is the closest standing water body to the proposed well sites, approximately 1.5 miles from the nearest proposed action site (87-13). The surface water closest to a proposed action well site is Paynes Springs, which is approximately 0.5 miles from existing well site 87-13.

Proposed activities would not affect the water levels in Medicine Lake because wells would be cased and cemented and geothermal fluids would be only be withdrawn and injected into the reservoir at least 3000 feet below. Implementation of the USGS hydrologic monitoring plan for the Glass Mountain area would provide a mechanism for monitoring lake levels and spring discharge.

Although neither surface spills nor storm water runoff present major concerns for surface water, CPN recognizes that accidental spills have the potential to occur when using, storing, and transporting drilling materials or geothermal fluids. The potential for spills would be minimized by the proposed operating procedures. The substances of concern for spills would include:

- Hydrogen sulfide abatement chemicals such as sodium hydroxide and hydrogen peroxide that would be onsite if abatement is needed
- Drilling muds
- Lubricating oils, fuel, or other petroleum products
- Geothermal fluids

CPN would implement a set of guidelines designed to minimize the effects of accidental spills (Appendix E, CPN 2002). Examples of guidelines are design features such as grading

and berming of the pads and implementation of an Emergency Spill Contingency Plan. Execution of these measures would prevent accidental spills from leaving the drill site areas, therefore no impact on surface water would occur from the Proposed Action.

Geothermal fluids generated during flow testing would be temporarily stored in the sump prior to injection back into the geothermal reservoir. The sumps would have a capacity of approximately 750,000-gallons. The sumps would be constructed with a clay liner to meet the RWQCB permeability standard of no more than $1x10^{-6}$ cm/sec. The liner would prevent infiltration of the sump fluids into shallow groundwater, in accordance with Regional Water Quality Control Board and GRO requirements. At least two feet of freeboard would be maintained in sumps to minimize the risk of overflows. In addition, well pads would be prepared to drain internally to prevent any accidental spills from leaving the drill pad. Sumps and reinjection pipelines have the potential to leak during an earthquake of magnitude 6.5 or greater. Mitigation would be implemented to reduce the impact of leaking fluids (Mt. Shasta Bioregional Ecology Center 2002).

The USGS hydrologic monitoring plan for the Glass Mountain Area (USGS 1994) is referenced to provide information regarding water quality at Medicine Lake and other surface waters in the area. CPN would also collect water samples at Paynes Springs before, during, and after drilling. The samples would be analyzed and drilling would be halted if the springs were affected by the drilling.

The proposed project is not expected to affect surface water due to the limited amount of surface water in the vicinity of the well sites and the distance to surface water from the wells (at least 0.5 miles). The effects of spills, if they were to occur, would be less than significant because CPN would implement spill prevention and emergency procedures to minimize effects.

Geothermal Resources

Drilling Effects. The objective of the project is to encounter and test a deep geothermal resource in the Fourmile Hill and the Telephone Flat project areas. The wells would be drilled with appropriate procedures including casing, cementing and mud programs designed to maximize the potential for geothermal production while preventing contamination of the shallower groundwater zones mentioned above. If drilling encounters the geothermal production zone, proper geothermal drilling practices would minimize the impact to the geothermal resource and geothermal fluid production would be suppressed until the drilling is complete.

Withdrawal of geothermal fluids would not significantly impact the shallow system or the groundwater available to support springs in the region because:

- The thermal and non-thermal groundwater systems are isolated from one another.
- Well casings are designed to seal off the geothermal liquids from adjacent groundwater systems.

Potential for Blowouts. Blowouts 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:

- Potential contamination of surface water and shallow groundwater resources

- Hazards to worker's health and safety
- Air impacts from emissions of gases such as H_2S (see section 4.6 for a discussion of potential effects to air quality from the release of H_2S into the air)

Blowout prevention equipment would minimize the risk of uncontrolled production of geothermal fluids. If a blowout were to occur, the majority of the geothermal fluid resulting from the blowout would be expected to drain into the on-site sump constructed of impermeable materials. All geothermal fluids would be contained on site.

Loss of Drilling Fluids. Drilling the proposed TGH and deep exploration wells would create a potential for drilling fluids to flow into subsurface porous rock formations and /or aquifers before a hole or well could be cased or lined. The potential effects are discussed below.

All drilling operations would be conducted in accordance with approved procedures. If there were a severe loss of circulation prior to setting the production casing, CPN would use one of the following measures to regain circulation:

- *The use of Lost Circulation Material (LCM):* LCM is material that is pumped downhole to seal openings in the subsurface formation. CPN would only use approved LCM.
- *Drilling Techniques:* Air, foam, or aerated mud drilling techniques (instead of or in addition to the normal drilling fluid) would be used to combat lost circulation.
- *Cement Plugs*: Cement would be pumped to fill the borehole interval and the fractures and pores immediately surrounding the interval. The cement would be allowed to cure to form a hard plug, which would then be drilled out. Normal drilling would then resume with full mud returns.

Site 64-27 TGH. The TGH would be drilled using continuous wireline core drilling, a technology substantially different from the rotary drilling method used for deeper exploration wells. Core drilling would use a hollow cylindrical bit that would cut a cylinder of rock (core) as it descends. The rock cores would be lifted out of the hole by wireline to allow drilling to continue. Only small amounts of material ground up by the bit would need to be lifted out by the drilling mud, and the hole diameter would be small enough, so much less mud circulation would be required. Portions of the TGH may be drilled without maintaining circulation of drilling fluid from the drill bit back to the surface; therefore, drilling fluids and ground rock could flow into any porous subsurface formations or aquifers that are encountered during drilling. The areal extent of the drilling fluid or ground rock migration would be limited, however, due to the nature of the subsurface formations and the minor amount of drilling fluids used.

Only non-hazardous drilling fluids would be used during drilling and would not substantially degrade or adversely affect any 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 (BLM et al 1995). Drilling of the TGH would therefore not be expected to adversely affect the hydrologic system in the vicinity of the well pad site.

Sites 64-27and 85-33 Exploration Wells. Drilling fluids would be circulated through the drill bit as it passed through subsurface rock formations lifting the drill cuttings to the surface.

Circulation of the drilling fluids would be maintained in the well bore prior to the setting of the production casing. Cement casings and a production liner would be used to maintain pressure and prevent the flow of drilling fluids into any porous subsurface formations or aquifers encountered during drilling. There is a potential for lost circulation in certain types of subsurface formations during the brief period during drilling before the well can be cased or lined. The potential for lost circulation would be minimal due to the nature of the subsurface formations. Only non-hazardous fluids would be used in drilling reducing the impact to local aquifers. As noted above, experience at other geothermal drill sites has indicated that temporary and minor releases of drilling fluids do not pose a significant threat to underground aquifers (BLM et al 1995). If there were a severe loss of circulation during drilling CPN would implement mitigation measures as described above a to regain circulation until the well can be cased or lined.

The CPN procedures would result in a less than significant effect if lost circulation were to occur.

Well Testing. After the well is completed, geothermal fluids would be produced to the surface through a separator and the surface muffler or silencer. The testing at each well (64-27, 85-33, 68-8, 31-17, and 87-13) would be short-term (30 days). The well testing would not produce a substantial amount of fluid (in relation to the reservoir volume) and would therefore have minimal effect on the geothermal resource. Geothermal well testing has not caused significant effects on geothermal reservoirs in the past. The flow tests would not be of sufficient duration or volume to have a significant impact on the geothermal reservoir.

Injection. The fluids produced during well tests would be temporarily contained in the sump at the pad. Fluids would then be piped to an existing well for injection back into the geothermal reservoir. CPN plans to use one or more wells for injection. Existing wells 17A-6, 87-13, 31-17 and 68-8 may be used for injection. On 17A-6, a short-term (up to 7 days) injection test would be performed to determine its suitability for injection.

A temporary pipeline would be used for transporting injection fluids from the well being flow tested to the injection well. The pipeline would be laid along the routes shown in Figure 2.2-10. Calpine shall drive and walk sections of the injection pipeline daily to monitor for any pipeline ruptures. If a rupture were discovered, Calpine would respond as it would if a spill were to occur on one of the well pad sites. Emergency protocol would follow the emergency response plan as listed in the POO (Appendix E).

Approximately 80% of the mass fluid produced during well testing would be returned to the reservoir (the remainder would flash to steam and evaporate into the atmosphere). The fluids would be injected away from the flow testing locations so flow test results would not be affected. The limited, short-term injection would not cause a significant effect on the geothermal reservoir.

MITIGATION MEASURES

Mitigation 4.3-1: Calpine shall inspect and promptly repair each sump, and pipeline after a seismic event of magnitude 5.0 or greater.

EFFECTS OF ALTERNATIVE B

No adverse effects to hydrologic or geothermal resources would result from Alternative B, the “No Action” alternative.

4.4 Cultural Resources

SIGNIFICANCE CRITERIA

The significance criteria discussed below are pursuant to the regulations discussed in Section 4.6 of the Fourmile Hill Geothermal Development Project EIS/EIR and identified in Section 3.4 of this document. The regulations include:

- National Historic Preservation Act of 1996, as amended
- American Indian Religious Freedom Act of 1978
- Executive Order 13007
- Executive Order 12898
- National Environmental Policy Act
- California Environmental Quality Act

Federal law requires the consideration of effects to historical and cultural resources prior to authorizing any activity. 36CFR296 (Protection of Archaeological Resources) and 36CFR800 (Protection of Historic and Cultural Properties) provide guidelines for the protection of cultural resources, 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 adversely affects a resource listed or determined to be eligible for listing on the National Register of Historic Places (NRHP).

At the state level, the CEQA Guidelines provide 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 major periods of California history or prehistory" would be a significant impact on the environment. 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". The CEQA Guidelines state 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 in 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 American Indian uses of an area. The American Indian Religious Freedom Act (PL 95-341) states that it is "...the policy of the United States to protect and preserve for American Indians their inherent right of freedom to believe, express, and exercise the traditional religions of the American Indian...including but not limited to access to sites, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites". The proposed project would have a significant effect if it were inconsistent with this policy and denied American Indian rights of freedom to exercise religion or access to sites.

Section 106 of the National Historic Preservation Act defines the following criteria of adverse effect to sites on or eligible for listing on the National Register of Historic Places as occurring "under conditions which include but are not limited to":

- Destruction or alteration of all or part of a property
- Isolation from or alteration of its surrounding environment
- Introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting
- Transfer or sale of a Federally owned property without adequate conditions or restrictions regarding preservation, maintenance, or use
- Neglect of a property resulting in its deterioration or destruction

METHODOLOGY

The impacts assessment for cultural resources and traditional cultural values is based on information collected for the Fourmile Hill and Telephone Flat Geothermal Development Projects. All of the sites considered are located within the Medicine Lake Highlands area and are included in the Memorandum of Agreement between the USFS, BLM, SHPO, and the Advisory Council on Historic Preservation (see Section 3.4).

Well sites included in the proposed action lie either within the Telephone Flat Project area or the Fourmile Hill Project area boundaries. Potential impacts to Traditional Cultural Properties (TCPs) are extrapolated from potential impacts associated with the Fourmile and Telephone Flat projects, drawn from the 1998 Ethnographic Report by Theodoratus et al. The Ethnographic Report includes research on all TCPs within the Medicine Lake Highlands (as well as Timber Mountain area).

EFFECTS OF PROPOSED PROJECT

Potential impacts to cultural resources in the project area are described in terms of the distance of identified cultural resource sites to the five sites included in the proposed action (see Table 4.4-1).

Prehistoric and Historic Resources

Fourmile Hill Area. Previous surveys and excavations have produced few chronologically sensitive prehistoric artifacts in the Medicine Lake Highlands area (BLM et al. 1995a). No

eligible or listed NHRP sites have been identified in the Fourmile Hill area of the proposed project or its vicinity.

64-27. Proposed well pad site 64-27 is located in an area previously disturbed by logging and thinning. The proposed action would result in approximately 2.5 acres of surface disturbance for construction of the well pad. This site has not been surveyed for the presence of cultural resources. The site will be surveyed as soon as the snow melts. If resources are found, Mitigation Measure 4.4-1 would be implemented to protect resources. There is a slight possibility that subsurface cultural resources might be discovered during site preparation, and if this occurs, Mitigation Measure 4.4-2 and/or 4.4-3 will be followed.

85-33. Proposed well pad site 85-33 is also located in a previously disturbed area. The site was cleared of vegetation in 2001 to 75x150 feet for use as a temperature gradient hole. It would be expanded to 360x360 feet. This site, including the proposed expansion area, was surveyed for presence of cultural resources. No resources were found at the site. The potential for finding buried resources during preparation of the pad site is slight, and if this occurs Mitigation measures 4.4-1, 4.4-2, and/or 4.4-3 would be followed.

Telephone Flat Area. The proposed flow testing at Well Pads 68-8, 31-17, and 87-13 would take place on existing well pads for existing deep wells. No additional surface disturbance would occur at these sites. Flow testing at these three existing well sites would not affect prehistoric or historic resources.

Pipeline Installation. The proposed project would include installation of a water/injection pipeline along the roads (see Figure 2.2-10). The pipeline route was surveyed for the presence of cultural resources. No resources were found along the pipeline route. Hand laying the pipeline on the side of the road would have no affect on cultural resources.

AMERICAN INDIAN CONCERNS AND EFFECTS TO TRADITIONAL CULTURAL VALUES

American Indian Concerns

American Indian groups use areas within the Medicine Lake Highlands for ceremonial and spiritual purposes and for periodically gathering natural resources. No specific sites of special significance to American Indian groups have been identified within or immediately adjacent to the proposed or existing well pads in the Fourmile Hill area or the Telephone Flat area. The proposed action would not impede access to traditional cultural properties nor would it prevent American Indian uses in the Medicine Lake Highlands.

As a result of the scoping and consultation process conducted for the Fourmile Geothermal Development Project and the Telephone Flat Development Project, American Indian groups have expressed concerns about geothermal-related impacts and development in the area (see 3.4 Cultural Resources and the EIS/EIRs for the development projects).

The projected environmental impacts of the proposed exploration project are discussed throughout Chapter 4 of this document. The environmental effects of geothermal resource development and utilization of the proposed well is beyond the scope of the exploration

EA/IS. The effects of development and utilization were addressed in the Fourmile Hill and Telephone Flat EIS/EIRs (BLM et al 1998 and BLM et al 1999).

Project Effects on Medicine Lake Area Traditional Cultural Properties

This section includes an analysis of potential impacts to the identified traditional cultural properties. Potential effects to historical properties and potential effects to American Indian cultural values are described in the following section. None of the proposed and existing well pads are within a TCP; effects on the Medicine Lake Area TCPs would be either audible effects or visual effects. Noise effects would result from both drilling and testing activities. Visual effects would result from visibility of the steam plumes and drill rig lights (nighttime views only) from the TCPs identified in the MOA. The methodology for analysis is described below.

Methodology

This impacts analysis is based on information gathered for the Ethnographic Report for the Fourmile Hill Geothermal Development Project, which present research conducted for all TCPs within the Medicine Lake Highlands. American Indian consultants identified specific traditional-use sites during interviews for the Fourmile Hill Project (Theodoratus and Emberson 1996; Theodoratus et al. 1998). The tribes requested that place names and locations of sites remain confidential and not be disclosed to the public. The identified sites are referred to by number in this analysis. The numbers are keyed to a table and map contained in the Ethnographic Report.

For each Traditional Cultural Property (TCP), analysis was performed for several environmental parameters. Effects identified in the Fourmile Hill EIS/EIR were examined in detail for each site on a parameter-by-parameter basis yielding quantitative and qualitative data relating the environmental effects to the specific sites.

The Fourmile Hill EIS/EIR included analyses of potential effects to traditional cultural uses associated with the TCPs including visibility, noise, odors, hydrology, and biological resources. For each identified TCP site, analysis was performed for distinct environmental parameters, including noise, odors, visibility. Potential effects associated with well pad construction, well drilling, and flow testing for sites 85-33 and 64-27 are extrapolated from the Ethnographic Report and the EIS/EIR based on their proximity to the Fourmile Hill project components and relative distances to TCPs. Potential effects associated with the well sites 68-8, 31-17, and 87-13 are extrapolated from the Ethnographic Report and the Telephone Flat EIS/EIR based on their proximity to the Telephone Flat area and relative distances to TCPs.

Table 4.4-1 shows distances from each of the five pads to 26 of the TCPs. The Medicine Lake Highlands area includes TCP numbers 1 through 26. The numbers of the TCPs correspond to the numbers and figures contained within the Ethnographic Report.

Audible Effects Assumptions. Ambient noise levels as opposed to site-specific data are used as basis for noise impacts because the ambient noise levels throughout the Medicine Lake area, including the TCPs, are fairly uniform and typical of rural areas. Ambient noise levels at the TCP sites are, on average, 30 dBA when people are absent. Human activities and other factors (such as traffic, rifle noise, motorboat use on Medicine Lake, logging noise, and airplanes) increase ambient noise levels at the sites. Typically sound level

increases of 5 dBA or more above ambient noise levels are considered audible. Potential impacts associated with increases in ambient noise levels are described in greater detail in Section 4.8 Noise.

Steam Plume Assumptions. The evaluation of visibility and visual effects of well venting plumes is also based on assumptions identified in the Fourmile Hill EIS/EIR regarding winter and summer plume size and atmospheric effects (see also Section 4.8 Visual Resources). Potential effects of the proposed project are extrapolated for those impacts identified in the Assessment of Effects for the Fourmile Hill and Telephone Flat project areas.

Visibility of Steam. The size and visibility of steam plumes are primarily related to ambient temperature and the resulting differences in evaporation rates. On hot, dry days with high evaporation rates, steam plumes may not be visible because higher ambient temperatures result in plumes that are less dense (opaque) and less visible. Steam plumes are usually most evident on cold days with lower evaporation rates. Wind conditions can make the visibility of steam plumes ephemeral, due to dispersion of the plume.

Forest visitors and residents may not readily distinguish steam plumes from clouds, fog, and other atmospheric features that may be experienced in the Medicine Lake area. Steam plumes, when visible, area considered by some as a positive impact in the KGRA since steam plumes contribute to the geologic character of the area.

The height of well venting plumes could range from 40 feet during the summer to 285 feet during the winter. The Assessment of Effects contained in the Fourmile Hill EIS/EIR also considered the visibility of steam plumes from a power plant which are much taller and potentially visible year round. A conservative approach is taken for the potential visibility of the steam plumes from various TCP locations.

Drill Rig Mast Lighting Assumptions. The drill rigs would have lights along the full length of the drill rig masts. Drill rig masts are 140- to 145-feet tall. Drill rigs are typically operated on a 24-hour basis when in use.

Potential Effects

The potential effects on TCPs are presented in Table 4.4-1. Impacts associated with the proposed action primarily concern views of the project activities and noise effects. Hydrogen sulfide is not expected to be detected at any of the TCPs.

Noise Effects. The proposed action would include activities (well pad construction, drilling, and/or flow testing) that may be either audible or potentially audible at nine of the TCPs (see Table 4.4-1). These are conservative estimates of audibility of noise associated with the proposed action and are based on the Effects Analysis completed for the Fourmile Hill and Telephone Flat Projects and would be contained within the HPMP per requirements of the Determination of Eligibility. Although some activities may be audible from these TCP sites, noise levels would be below the GRO standard of 65 dBA at the lease boundary or 0.5 miles from the source. The noise impacts would depend on wind direction, stage of drilling, and whether the TCP was being used during drilling. The proposed action activity noise may not be distinguishable from noise generated by other forest activities, such as logging, motorboats, hunting, and truck or recreational vehicle traffic. If project noise prevented American Indians from conducting ceremonial activities,

the effect would be significant. The proposed Mitigation Measures 4.4-4, 4.4-5, and 4.4-6 would reduce the potential effects to a less than significant level.

Some TCPs are located within 0.25 mile of identified access routes, and one TCP is located just off of an identified access route. Vehicle noise would occur sporadically and would not result in substantial increases in ambient noise levels or expose people to severe noise levels. Increases in noise levels due to the proposed project would not be significant in relation to ambient noise levels along the access roads.

Visual Effects. The proposed action would result in activities (steam plume and well pad lighting) that would be visible or potentially visible from 14 of the TCPs (See Table 4.4-1). The drill rig mast and steam plumes would be visible from some of the TCPs. The well pads would not be visible. These are conservative estimates of visibility of steam plumes and well pad lighting associated with the proposed action. These impacts would depend on the direction of sight during ceremonial activities. If views are not in the direction of the project facilities, there would be no effect. Effects would be less than significant from many TCPs due to the distance to the proposed activities and the difficulty in seeing the facilities against a forest backdrop. Drill rig masts and lights are often difficult to distinguish against the dark forest canopy. The visual effects would be expected to be temporary and less than significant.

Summary. The proposed project would not have direct effects on known TCPs. The nearest known TCP is 0.75 miles away from the closest proposed project site (distance from TCP site 7 to 85-33 and site 18 to existing pad 87-13). One TCP is located just off of an identified access route. Noise levels are expected to be less than 44 dBA at the closest site (see Table 4.7-1). This is significantly lower than the threshold of 65 dBA. Noise levels generated by project traffic would not be a significant increase in ambient noise levels along access routes. The proposed project is not expected to conflict with American Indian use of traditional cultural sites.

Pit River and Klamath Tribe consultants indicated in the Assessment of Effects conducted for Fourmile Hill that alterations in the existing environment associated with the development project would be “out of character” and would constitute effects on the cultural integrity of the sites. Effects of the proposed exploration project on the integrity of sacred sites are primarily audible and visual impacts. The proposed action would have substantially less audible and visual effects than the Fourmile Hill and Telephone Flat multiple well pad, power plant, and transmission line development projects. The audible and visual effects of the project may be noticeable at some TCPs if tribal use of the sites coincides with drilling nearby. If project noise prevents American Indians from conducting ceremonial activities at the site, the effect would be a significant effect.

The BLM/USFS will notify the tribes and provide the project Decision Notice when the decision is made whether or not to approve the proposed project.

Table 4.4-1: Distance from the Well Pad Sites to Identified Traditional Cultural Properties (TCPs)

	Distance from TCP to Each Site				
TCP	**Proposed Pad 64-27**	**Proposed Pad 85-33**	**Existing Pad 68-8**	**Existing Pad 31-17**	**Existing Pad 87-13**
1	9.5 miles	8.5 miles	12.75 miles	12 miles	10.5 miles
	NV, NA	NV, NA	NV, NA	NV, NA	NV, NA
2	10.75 miles	9.75 miles	12.8 miles	12.5 miles	11 miles
	NV, NA	NV, NA	NV, NA	NV, NA	NV, NA
3	7 miles	5.75 miles	9.1 miles	9.75 miles	8.25 miles
	NV, NA	NV, NA	NV, NA	NV, NA	NV, NA
4	7 miles	5.75 miles	9.25 miles	9 miles	7.25 miles
	NV, NA	NV, NA	NV, NA	NV, NA	NV, NA
5	8.1 miles	7 miles	9.25 miles	8.75 miles	7.25 miles
	NV, NA	NV, NA	NV, NA	NV, NA	NV, NA
6	4 miles	2.5 miles	6.5 miles	6 miles	4.75 miles
	NV, NA	PV, NA	NV, NA	NV, NA	NV, NA
7	2 miles	0.75 miles	5.75 miles	5.5 miles	4.5 miles
	V, PA	V, A	NV, NA	NV, NA	NV, NA
8	2.5 miles	1 mile	5 miles	4.5 miles	3.5 miles
	NV, PA	PV, PA	NV, NA	NV, NA	NV, NA
9	2.1 miles	3.5 miles	7.25 miles	7 miles	7 miles
	V, PA	PV, NA	NV, NA	NV, NA	NV, NA
10	1 mile	2.25 miles	6.5 miles	6.25 miles	6 miles
	PV, PA	NV, NA	NV, NA	NV, NA	NV, NA
11	4 miles	3 miles	4 miles	3.5 miles	2 miles
	NV, NA	NV, NA	NV, NA	NV, NA	PV, NA
12 (Medicine Lake)	2.75 miles	1.75 miles	2.5 miles	2 miles	1.5 miles
	NV, NA	PV, PA	NV, NA	NV,PA	NV, PA
13	2.1 miles	1.75 miles	3.5 miles	3.5 miles	2.75 miles
	NV, PA	PV, PA	NV, NA	NV, NA	NV, NA
14	2.5 miles	3 miles	2.75 miles	2.5 miles	2.75 miles
	NV, NA	NV, NA	NV, NA	NV, NA	NV, NA
15	8 miles	7.5 miles	4.5 miles	4 miles	3.25 miles
	NV, NA	NV, NA	NV, N A	NV, NA	NV, NA

Table 4.4-1: Distance from the Well Pad Sites to Identified Traditional Cultural Properties (TCPs) cont'd.

	Distance from TCP to Each Site				
TCP	**Proposed Pad 64-27**	**Proposed Pad 85-33**	**Existing Pad 68-8**	**Existing Pad 31-17**	**Existing Pad 87-13**
16	5.25 miles	7 miles	8.25 miles	8.25 miles	9 miles
	NV, NA	NV, NA	NV, NA	NV, NA	NV, NA
17	3 miles	3.75 miles	2.75 miles	3 miles	3.5 miles
	NV, NA	NV, NA	PV, NA	PV, NA	PV, NA
18	5.25 miles	4.75 miles	1.1 miles	1 miles	0.75 miles
	NV, NA	NV, NA	NV, PA	NV, PA	NV, PA
19	7.25 miles	6.5 miles	2.75 miles	2.5 miles	2.25 miles
	NV, NA	NV, NA	PV, NA	PV, NA	PV, NA
20	5.5 miles	6 miles	0.8 miles	1.25 miles	2.75 miles
	PV, NA	PV, NA	V, PA	V, PA	PV, PA
21	6 miles	6.5 miles	1.1 miles	1.75 miles	3.25 miles
	PV, NA	PV, NA	PV, NA	PV, NA	PV, NA
22	5.75 miles	6.5 miles	2.5 miles	3 miles	4.5 miles
	NV, NA	NV, NA	PV, NA	PV, NA	PV, NA
23	5.1 miles	6.5 miles	4.5 miles	5 miles	6 miles
	NV, NA	NV, NA	NV, NA	NV, NA	NV, NA
24	7.5 miles	8.75 miles	6.75 miles	7 miles	8.25 miles
	NV, NA	NV, NA	NV, NA	NV, NA	NV, NA
25	16.5 miles	17.25 miles	13.1 miles	13.5 miles	15 miles
	NV, NA	NV, NA	NV, NA	NV, NA	NV, NA
26	17.5 miles	18.25 miles	14.75 miles	15.25 miles	17 miles
	NV, NA	NV, NA	NV, NA	NV, NA	NV, NA

KEY:

NA, PA, A=not audible, potentially audible or audible from the TCP

V, PV, NV=Visible, Potentially Visible, and Not Visible from the TCP

NOTES:

The American Indian tribes that identified the Traditional Cultural Properties (TCPs) requested that place names and locations of sites remain confidential and not be disclosed to the public. The identified sites are referred to by number in this analysis (presented in the table below). The numbers are keyed to a table and map contained in the Ethnographic Report (Theodoratus and Emberson 1996; Theodoratus et al. 1998) prepared for the Fourmile project (not for public use).

For the purposes of this analysis, a steam plume is deemed to be potentially visible from 1.5 to 2 miles away. A distance of 1.5 to 2 miles is considered conservative as steam plumes would dissipate (at a height of 40

feet) more easily during the summer months and are similar in appearance to natural condensation formations around the Medicine Lake Highlands.

SOURCE: MHA Environmental Consulting, Inc. 2002. Based on information contained in the Historic Properties Management Plan and data collected by Dr. Theodoratus (Theodoratus and Emberson, 1996; Theodoratus et al, 1998). Table reads column to row (i.e. Historic Property # x is x miles from well pad site y).

MITIGATION MEASURES

Mitigation Measure 4.4-1

The USFS shall conduct a cultural resource survey on Well Pad Site 64-27 prior to issuance of a Decision Notice for the project. If the survey results in the discovery of a previously undocumented cultural resource site, the proposed action would be postponed until consultation has taken place and the resources have been appropriately evaluated or treated and specific authorization to begin construction activities is provided by the USFS. Mitigation to avoid effects to eligible sites might include avoidance or data collection. The mitigation plan would be consistent with previous mitigation programs in the area.

Mitigation Measure 4.4.-2

Should any prehistoric or historic resources be encountered during site construction activities, construction activities within 50 feet of the discovery would be suspended until the USFS and a qualified consulting archaeologist have assessed the materials. If a decision is made to record the site, recordation shall take place and it will be determined whether project well sites could be relocated to avoid any additional effects. Construction activities in the vicinity of the discovery would not resume until consultation has taken place and the resources have been appropriately evaluated or treated and specific authorization to resume construction activities is provided by the USFS. If avoidance is not feasible, the site will be evaluated by a qualified archaeologist and a determination of eligibility for the NRHP shall be made. If the site is determined to be eligible, then a mitigation proposal (which may include a data recovery program similar to those conducted for similar resources in the vicinity) shall be submitted with the site record to the SHPO for review and concurrence.

Mitigation Measure 4.4-3

If prehistoric archaeological deposits that include human remains or objects considered "cultural items" according to the Native American Graves Protection and Repatriation Act (NAGPRA) are discovered during site construction activities, the County Coroner and a qualified archaeologist would be immediately notified and NAGPRA regulations shall be followed. If the remains are identified as American Indian, then local American Indian groups or tribe(s) and the Native American Heritage Commission (NAHC) are required to be notified within 24 hours and consultation will be initiated. The most likely descendants of these remains would be notified and given the opportunity to make recommendations for the remains. If descendant recommendations are made which are not acceptable to the operator or USFS, then the NAHC would be requested to mediate the problem.

Mitigation Measure 4.4-4

CPN shall provide at least 30 days notice to concerned tribes prior to beginning activities for the proposed project. The notice to the tribes shall include the specific location, date of commencement, and expected schedule and duration of the project activities and phases. This notice may be given prior to a decision on the project.

Mitigation Measure 4.4-5

CPN shall designate an authorized representative who may be contacted by tribal members during the proposed well drilling activities to determine activity schedules; this would reduce the potential for interference with American Indian activities in the project area during project activities. The CPN representative's name and telephone number shall be provided prior to the commencement of the proposed pad construction, well drilling, and well testing activities.

Mitigation Measure 4.4-6

If requested by tribal members or agencies, CPN shall meet with American Indians to determine methods to minimize conflicts with ceremonial activities. CPN shall implement additional measures to reduce conflicts identified by tribal members. Measures may include installing additional noise attenuation materials (such as hay bales or other sound absorbing materials), revising schedules, or reducing testing times to the minimum required to gather reservoir data (as determined by the BLM).

EFFECTS OF THE NO ACTION ALTERNATIVE

There would be no cultural resource effects from implementation of the No Action alternative.

4.5 Biological Resources

SIGNIFICANCE CRITERIA

Federal and California endangered species laws require protection of listed endangered or threatened species. Other special-status species include those proposed for listing or designated as species of concern by the USFWS, as well as species of special concern identified by the CDFG, the CNDDB list, CNPS's *Inventory of Rare and Endangered Vascular Plants of California*, and the USFS Sensitive plant lists. CEQA also provides protection for rare and endangered plant species regardless of whether they are formally listed. In addition, USFS policy is to protect "sensitive" and "special interest" species as part of its overall policy to protect all native plant species. If the proposed action would affect the range of, or eliminate an endangered, threatened, or other special-status species, or result in take of such species, it would be considered a significant impact.

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 special status species, threaten to eliminate an animal or plant community, or reduce the number or restrict the range of a rare or endangered species. CEQA Guidelines state 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 plants or wildlife.

Section 15380 of the CEQA Guidelines further defines "rare and endangered species" as those species officially listed as threatened, endangered, or rare under Federal or California law. In addition, the Guidelines provide that species may be treated as "rare or endangered" even if not on one of the official lists under the following circumstances:

- 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

Species would also be considered rare and endangered if listed as a sensitive species by the USFS.

EFFECTS OF PROJECT ALTERNATIVE A

The construction of the well pad sites would involve the removal of small amounts of potential wildlife habitat and vegetation. The proposed project construction could have a substantial adverse effect, either directly or through construction-related habitat modifications, on certain special status species. Project activities, such as drilling and flow testing, would result in limited, short-term noise and increased activity in the project areas during proposed project operations. Fluids and gas associated with project operations

could also adversely affect vegetation and animals in the project area. Many potential special status species (e.g., the special status species listed in Section 3.5 and MIS animals Appendix D) do not occur or do not have habitat in the proposed project area and would not be impacted by project activities. Certain special status wildlife that either occur or have the potential for occurring in the proposed project area (e.g., the species listed in Tables 3.5-4) could be adversely affected by project operations.

The proposed project would not interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors or impede the use of native wildlife nursery sites. There are no significant sources of surface water located within the proposed project area that would be affected by drilling. The proposed project would have no impact on fish.

The proposed project would not have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations, or by the CDFG or USFWS. The proposed project area does not include any floodplains, wetlands/riparian areas, or Wild and Scenic River areas. The proposed project would have no impact on riparian vegetation.

The proposed project would not have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means. The proposed project would have no impact on wetlands.

The proposed project would not conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance. The proposed project would have no impact on local policies or ordinances protecting biological resources.

The proposed project would not conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan. The plan is consistent with applicable Forest Plans. The proposed project would have no impact on other conservation plans.

The following specific impacts and mitigations were identified in previous environmental documents generated for the Fourmile Hill and Telephone Flat geothermal exploration and development projects (BLM et al. 1995a, 1998, 1999; Siskiyou County 2001). The measures have been modified and updated according to the specifics of the proposed project. Mitigation measures are identified below that would reduce any potential impacts to vegetation, wildlife, and wildlife habitat to less than significant levels.

VEGETATION

Potential Impact Overview

Small amounts of vegetation in the immediate drill site areas would be lost. Vegetation will be cleared during the widening and construction of the proposed well sites and associated sumps in the area. Approximately three additional acres of thinned lodgepole pine habitat and previously disturbed area would be cleared around well sites 85-33 and 64-27. Extremely small amounts of small-sized, non-woody vegetation (e.g., weeds, forbs) would be removed from existing roads leading to well sites and existing well areas and sumps at sites 68-8, 31-17, and 87-13. Chemicals released in gases during operational activities also could affect local vegetation in the project sites, but the trace amounts of

project chemicals and the relatively short period of time during which they could be deposited make adverse impacts unlikely. The impact to the vegetative communities would be minimal and therefore would not warrant any mitigation because sensitive plant communities are not found in the project area and would not be affected by the project.

Impact 4.5-1: Vegetation removal and/or contamination

Vegetation would be removed as a result of the construction of the well sites for the proposed project. Minimal amounts of vegetation would be removed around the two well sites, which exist in currently cleared (i.e., logged and thinned) and/or disturbed areas. Approximately 6 acres of total land would be cleared at sites 64-27 and 87-13. This impact is considered less than significant and no mitigation measures are recommended.

Chemicals contained in the geothermal steam released during flow testing (primarily boron and bicarbonate) have the potential to adversely affect vegetation via deposition. The trace amounts of these chemicals, and the relatively short period of time during which they could be liberated and deposited, make adverse impacts unlikely. Depositional effects of the proposed project on vegetation would be less than significant due to the limited, 30-day testing periods.

Impact 4.5-2: Noxious Weeds

Noxious weeds are not present in the disturbed areas of the project sites; however, project-associated surface disturbance could create a favorable environment, and use of construction equipment from outside areas provides a transport means, for introducing noxious weeds to the project areas. This impact is considered less than significant because of the minimal construction activity associated with the project and the remote location of the sites. No mitigation measures are required, but Mitigation Measures 4.5-1 would further reduce the adverse effects of surface disturbance on native vegetation posed by the potential introduction of noxious weeds.

Mitigation Measure 4.5-1. CPN shall develop and implement a program for weed monitoring and control satisfactory to the USFS following completion of construction to control any spread of noxious weeds that could occur. CPN shall be responsible for thoroughly washing all heavy equipment prior to moving the equipment into the Medicine Lake Highlands. Cars and trucks with the potential to transport noxious weeds or seeds, such as those carrying debris, mud, or soil from sites with existing weeds, will be washed as appropriate.

SENSITIVE VEGETATION SPECIES

Impact Overview

The proposed well sites would occur on existing well pads or previously cleared areas that support little vegetation; however, additional, but minimal, thinned/disturbed land would be cleared to develop sites 64-27 and 85-33. Special status plant species grow in small numbers on existing well pad 87-13 and could also be found in other sites in the Fourmile Hill and Telephone Flat project areas. Several special status plant species that either occur or have the potential for occurring in the proposed project area could be adversely affected by project operations. Table 4.5-1 summarizes impacts to special status

plants present or potentially present at the project sites; specific potential impacts and mitigation measures, if necessary, are identified below.

Table 4.5-1: Summary of Potential Impacts to Special Status Plants at the Project Sites

Species	Potential Impact
Ash penstemon *(Penstemon cinicola)*	Destruction of existing plants at well pad 87-13 via clearing or maintenance activities
Boggs Lake hedge-hyssop *(Gratiola heterosepala)*	Destruction of existing plants in Telephone Flat well pad sumps via high-temperature fluid storage or sump maintenance activities
California pinefoot *(Pityopus californicus)*	Destruction of plants during project clearing activities
Hall's sedge *(Carex halliana)*	Destruction of existing plants at well pad 87-13 via clearing or maintenance activities
Liddon's sedge *(Carex petaseta)*	Destruction of plants during project clearing activities
Sugar stick (*Allotropa virgata*)	Destruction of plants during project clearing activities

SOURCE: BLM et al. 1990 , BLM et al. 1995 and BLM et al. 1998

Impact 4.5-2: California Pinefoot, Liddon's Sedge, and Sugar Stick

California pinefoot, Liddon's sedge, and sugar stick, all special status species, are known to occur within the Fourmile Hill and/or Telephone Flat well site areas. Project activities could adversely affect this species through vegetation clearing. This impact is considered potentially significant. Mitigation Measures 4.5-2a, 4.5-2b, and 4.5-2c would reduce the adverse effects of the impact to below the level of significance.

Mitigation Measure 4.5-2a. As identified in the POO, CPN shall retain a botanical resources consultant to survey vegetation communities most likely to serve as potential California pinefoot, Liddon's sedge, and sugar stick habitat prior site-specific ground disturbing activities. If the consultant identifies plants or colonies, they will be marked and avoided during clearing and construction activities.

Mitigation Measure 4.5-2b. Project activities in the vicinity of populations of California pinefoot, Liddon's sedge, and sugar stick shall be conducted so that both the plants of this species and their microhabitat are preserved. The integrity of the crowns and root systems of the plants, and of the living host trees upon which the mycotrophic sugar stick grows, shall be maintained during on-site construction activities.

Mitigation Measure 4.5-2c. CPN shall maintain an adequate supply of coarse woody debris in the vicinity of sugar stick populations, in accordance with the objectives for management of this species identified in "Draft Management Recommendations for Sugar Stick" (Wogen 1996). CPN shall maintain appropriate habitat requirements for the California pinefoot and Liddon's sedge, if present, in accordance with approved management objectives for the species.

Impact 4.5-4: Boggs Lake Hedge-hyssop

Boggs Lake hedge-hyssop could be lost or adversely impacted by activities at the Telephone Flat well site sumps or by storage of high-temperature fluids in the sump during the plant's growth season. This impact is considered potentially significant. Mitigation measure 4.5-3 would reduce the adverse effects of the impact to below the level of significance.

Mitigation Measure 4.5-3. A vegetation survey of the sumps shall be conducted as outlined in the POO. If Boggs lake hedge-hyssop plants are present at any Telephone Flat well sites or sumps, they shall be avoided to the maximum extent possible during on-site construction and pumping activities. Additionally, seed shall be collected from all individual hedge-hyssops prior to ground disturbing activities in the sump area or the discharge of hot fluids to the sump. Seed shall be collected from the current year plants after they are fully mature.

Impact 4.5-5: Ash Penstemon

Individuals of ash penstemon present on well pad 87-13 would not be lost or adversely impacted by the project. These plants have been found on or above the bordering cut banks, off the surface of the well pad, and outside of any project activity zones. This impact is considered less than significant and no mitigation measures are required.

Impact 4.5-6: Hall's Sedge

Individuals of Hall's sedge could be damaged or lost due to project activities at well pad 87-13. This impact is considered potentially significant. Mitigation measures 4.5-4a and 4.5-4b reduce this impact to a less than significant level.

Mitigation Measure 4.5-4a. After vegetation surveys have been conducted as part of the project POO, any identified individuals or colonies of Hall's sedge shall be marked and avoided during site construction and operational activities.

Mitigation Measure 4.5-4b. Colonies of Hall's sedge that cannot be avoided shall be salvaged and planted on recently constructed, low-use slopes. Salvaging shall take place in the fall season when the plants have completed their seed set and full measure of their annual growth.

Impact 4.5-7: Non-vascular Plants

Special status species of non-vascular plants (i.e., fungi, lichens, and bryophytes) are located in the project areas. Populations of these fungi could be adversely affected by well site construction activities. Specific field surveys prior to ground-disturbing activities are not required by the NFMP. The majority of project-associated activities would take place in thinned, cleared, and disturbed areas, which are unlikely to provide habitat for non-vascular plants because of the high level of exposure. This impact is considered less than significant and no mitigation measures are required.

WILDLIFE

Impact Overview

Small amounts of wildlife habitat would be removed during the construction of well pad sites and sumps. Potential cover and forage for animals could be lost at each site. Vegetation will be cleared during the widening and construction of the proposed well sites and associated sumps in the area. Approximately three additional acres of thinned lodgepole pine habitat and previously disturbed area would be cleared around each of the well sites 85-33 and 64-27. Although the area to be cleared may contain some snags, it is low-quality habitat for animals because it is disturbed and thinned. Extremely small amounts of small-sized, non-woody vegetation (e.g., weeds, forbs) would be removed from existing roads leading to well sites and existing well areas and sumps at sites 68-8, 31-17, and 87-13 as part of maintenance activities. This vegetation does not provide cover or significant forage for animals because of its limited size and distribution. The amount of cover lost is a small amount of acreage and would not measurably change the cover/forage ratio in the already disturbed areas or local area.

Disruptions to wildlife from increased, temporary project construction and activity and noise could occur in the vicinity of Fourmile Hill and Telephone Flat well site areas. Increased drilling and flow-testing activity and noise within a 0.25-mile radius of a raptor nests, mammal dens, and bat roosts, especially during sensitive breeding/nesting periods, may cause wildlife to abandon these sites. New sources of water, in the form of sumps, could attract wildlife for feeding and drinking. Harassment of wildlife in the area may occur if human use increases after opening project access roads that are usually blocked or gated.

Table 4.5-2 summarizes potential impacts to special status species in the project area; specific impacts and mitigation measures, if necessary, are described below.

Table 4.5-2: Summary of Potential Impacts to Special Status Animals Occurring or With the Potential to Occur at the Project Sites

Species	Potential Habitat Affected	Potential Impact
Birds		
Blue grouse	L-F, R, C	V, H, N
Cooper's hawk	L-F, R, C	V, H, N
Golden eagle	L-F	V, H, N
Hairy woodpecker	L-F, R, C[1]	V, H, N
Northern goshawk	L-F, R, C[1]	V, H, N
Northern spotted owl	L-F, R, C	V, H, N
Osprey	L-F, R[1]	V, H, N
Pileated woodpecker	L-F, R, C[1]	V, H, N
Bats		
Fringed myotis	L-F, R[1]	V, H, N
Long-eared myotis	L-F, R, C[1, 3]	V, H, N
Long-legged myotis	L-F, R, C[1, 3]	V, H, N
Pallid bat	L-F[1]	V, H, N
Silver-haired bat	L-F, R, C[1, 3]	V
Townsend's big-eared bat	L-F	V, H, N
Western mastiff bat	L-F[1]	V, H, N
Western small-footed myotis	L-F, C[1]	V, H, N
Other Mammals		
American marten	L-F, R, D[2]	V, H, N
Mule deer	L-E, F, T	V, H, N
Oregon snowshoe hare	L-E, F, R, C	V, H, N
Pacific fisher	L-F[2]	V, H, N

[1] including tree snags; [2] logs and coarse woody debris; [3] exfoliating tree bark

L = thinned lodgepole pine area surrounding proposed well sites

C = cover for roosting, resting; D = denning, E = escape, F = foraging/hunting, R = reproduction/breeding, T = thermal protection

H = Disturbance due to human activity, N = Disturbance due to temporary project noise, V = loss of vegetation/habitat

SOURCE: MHA 1997 and Leitner 1997, BLM et al. 1995, BLM et al. 1998, BLM et al. 1999

Impact 4.5-8: Wildlife Habitat

There would be a general loss or modification of wildlife habitat as a direct and indirect result of project construction and operations activities. This impact is considered less than significant and no mitigation measures are required because of the small amount (approximately six acres) of low-quality, thinned/disturbed lodgepole pine habitat that would be affected by the proposed project. The small amounts of non-woody vegetation removed from existing access roads and at existing well pad sites do not provide significant cover or forage habitat for local animals. Measures provided below to reduce the adverse effects of the project on special status wildlife species would also reduce the adverse effects of the project on general wildlife species and habitat.

Impact 4.5-9: Wildlife Foraging and Dispersal

Foraging and dispersal habitat for wildlife within the project areas could be fragmented by well site development activities; however, only two well sites would be developed, and a small amount of low-quality, disturbed and thinned lodgepole pine habitat would be lost. Approximately 3 acres of habitat would be cleared for the two proposed Fourmile Hill well sites, which are located approximately 2 miles apart. Existing well sites in the Telephone Flat area are small, relatively widely spaced, and unlikely to result in a hindrance to foraging and dispersal movement. This impact would be less than significant and no mitigation measures would be required.

Impact 4.5-10: Snag Habitat

Some tree snags could be lost as a result of surface disturbance associated with the implementation of the project. This impact is considered less than significant because of the small amount of snag habitat that would be removed as part of the well site development. Mitigation Measure 4.5-5 would further reduce potential impacts to snag habitat.

Mitigation Measure 4.5-5. Prior to proposed drill site construction, the proposed drill site locations would be inspected to identify mature trees (greater than 14 inches diameter at breast height (dbh) and snags, and the pad design and/or access road routes would be modified, to the extent practical, to minimize clearing of mature trees or removal of large snags. Drill pads would be constructed to avoid as many snags and seed trees as possible.

Impact 4.5-11: Northern Goshawk Habitat

Northern goshawk foraging habitat available within the area could be lost. Construction could result in the removal and loss of northern goshawk nesting habitat, and disturbance (particularly during nesting activities) due to noise. This impact is considered potentially significant. Mitigation Measures 4.5-6a and 4.5-6b would reduce the adverse effects of the impact to below the level of significance.

Mitigation Measure 4.5-6a. As identified in the project POO, pre-construction surveys for new goshawk nests at and near (within 0.25 miles) the well pad sites at Telephone Flat shall be conducted by a qualified biologist. Additionally, and in all project areas, the biologist, in consultation with a USFS biologist, shall conduct a field visit, prior to project commencement or when snow clears, to verify that biological conditions have not changed from conditions identified in previous site surveys. Specifically, the biologist shall check for new goshawk nests and identify suitable habitat within 0.5 mi of the existing well pads, using appropriate agency protocols. If nests are found within 0.5 miles

of well pads, seasonal drilling restrictions may be enforced by the USFS to avoid impacts to nesting goshawks. Activities could be restricted from March 1 to August 31 if a goshawk nest is located less than 0.5 miles from the pad. If new goshawk nests are identified, CPN shall consult with the USFS biologist to define any other measures to ensure no significant effects would occur from project activities.

Mitigation Measure 4.5.6b: All field employees and personnel working at the drill sites would be educated on the importance of isolating the goshawk nest stand from noise and unnecessary human activity, and all but specifically authorized and necessary personnel would be prohibited from conducting any field activities within 0.5 mile of the goshawk nest stand unless authorized by the USFS.

Impact 4.5-12: Cooper's Hawk and Golden Eagle Habitat

Cooper's hawk and golden eagle foraging habitat available within the project area could be lost; however, the amount of potential habitat would be relatively small. The project POO currently stipulates that raptor surveys will be completed prior to project construction. This impact is considered less than significant and Mitigation Measure 4.5-7 would further reduce potential impacts to these raptors.

Mitigation Measure 4.5-7. A consulting biologist, in concert with the USFS biologist, shall visually survey within a 0.5-mile radius of the proposed site to ensure no other listed raptor species nesting is taking place. If nests are found within 0.5 miles of well pads, seasonal drilling restrictions may be enforced by the USFS to avoid impacts to nesting raptors. Activities could be seasonally restricted if a raptor nest is located less than 0.5 miles from the pad. If new nests are identified, CPN shall consult with the USFS biologist to define any other measures to ensure that no significant effects would occur from project activities.

Impact 4.5-13: Blue Grouse, Pileated Woodpecker, and Hairy Woodpecker Habitat

Habitat could be lost for blue grouse, pileated woodpecker, and the hairy woodpecker. This impact is considered less than significant and no mitigation measures are required because the amount of habitat lost would be extremely small.

Impact 4.5-14: Northern Spotted Owl Habitat

Northern spotted owls were not found in the Fourmile Hill or Telephone Flat project areas. The USFS has determined that portions of the Telephone Flat well site areas are potential owl habitat. No potential owl habitat would be lost for the owl as a result project activities in the Telephone Flat area. Owl surveys were not previously required by the USFS in this area for the Telephone Flat development project (BLM et al. 1995a, BLM et al. 1999); the project POO specifies surveys for the owl only as requested by the USFS. The project is unlikely to result in significant impacts to the northern spotted owl, and no mitigation measures are required.

Impact 4.5-15: Osprey Habitat

No habitat would be lost for osprey foraging and nesting in the Telephone Flat project area. This impact is considered less than significant and no mitigation measures are required because: a) no new surface disturbance would occur in the Telephone Flat area and b) the well site areas do not contain prime osprey foraging features or confirmed nests.

Impact 4.5-16: Marten Habitat

Potential marten denning and foraging habitat available within the project area would be lost; however, this habitat loss would be relatively small (approximately 6 acres). The project POO also outlines continued marten monitoring efforts in the project area. This impact to marten foraging and denning habitat is considered less than significant and no mitigation measures are required. Mitigation Measure 4.5-8a, 4.5-8b, and 4.5-8c would reduce effects to denning habitat to even lower levels.

Mitigation Measure 4.5-8a. A qualified biologist shall conduct a field visit, prior to project commencement or when snow clears, to verify that biological conditions have not changed from conditions identified in previous surveys. Specifically, the biologist shall check for marten dens within 250 ft of existing or proposed well pads. If new marten dens are identified, the CPN shall consult with the USFS biologist to define measures to ensure no significant effects would occur (such as the measures outlined in Mitigation Measure 4.5-8b).

Mitigation Measure 4.5-8b. In order to minimize the potential impact to martens using den sites in the well pad area, all proposed facility locations shall be checked by a qualified biologist for log piles, hollow logs, and other suitable denning structures at least one month before construction and once again immediately prior to construction. Any log piles, felled and bucked hollow logs, or other potentially suitable marten denning structures which exist on a drill site would be disassembled or removed slowly and carefully under the supervision of a qualified biologist. If marten are detected, activity shall cease to allow the animal to escape safely. The log piles, hollow logs, or other structures would be reassembled at the periphery of the drill site to allow for use as potential dens.

The CPN shall retain as many tree snags as possible during construction to provide denning and loafing areas for the American marten to reduce the effect on this species. Logs from construction shall be piled. Piles may be of various sizes and shapes and may be placed at any convenient locations throughout the area in accordance with NFMP and LRMP standards and guidelines for downed logs. Coarse woody debris that is already on the ground shall be retained and protected from disturbance during logging and other construction activities that might destroy the integrity of the substrate.

Mitigation Measure 4.5-8c: At least one day immediately prior to construction of each drill site, low-level intrusive disturbance (e.g., individuals camping at the site) would be conducted on the drill site in an effort to stimulate any marten denning on or near the drill site to vacate the area prior to the drill site construction activities.

Impact 4.5-17: Bat Habitat

Bat nocturnal and diurnal roost sites could be destroyed during construction. This impact is considered potentially significant. Implementation of Mitigation Measure 4.5-9a and 4.5-9b would reduce the adverse effects of the impact to below the level of significance.

Mitigation Measure 4.5-9a. The Project CPN shall survey for roosting bats in accordance with the draft bat roost survey protocol provided in the NFMP, and preferred bat roosting habitat according to the project POO. Surveys shall be conducted within the footprints of all proposed facilities (i.e., well pads, access and maintenance roads) and for a distance of 250 feet surrounding the facilities. If cave roosting bats are located, a site-specific hat roost

management plan shall be prepared for USFS approval and implemented by the CPN. The entire cave system(s) shall be safeguarded, including, but not limited to, cave entrances, skylights, collapsed areas of the cave system(s), and interconnected passages that occur beneath the surface of the earth. Bat maternity colonies, day roosts, hibernacula, and night roosts would be protected. The removal of snags and defective trees with dbh of 18 inches or more will be avoided to the greatest extent possible during construction of project facilities.

Mitigation Measure 4.5-9b. If caves are located during the bat roost surveys, the caves shall be assessed as to their being "significant" as defined by the Federal Cave Resources Protection Act of 1988, regardless of bat occupancy. If deemed signficant, these resources shall be protected according to the guidelines outlined in the Act.

Impact 4.5-18: Mule Deer, Oregon Snowshoe, and Pacific Fisher Habitat

A small amount of relatively low quality mule deer foraging, thermal, and escape cover habitat would be lost in the Fourmile Hill area as a result of the project. A small amount of marginal to potentially suitable habitat for pacific fisher and snowshoe hare would also be lost in the Fourmile Hill area. Because of the small overall amount and low quality of these potential habitats, this impact is considered less than significant and no mitigation measures are required.

SENSITIVE WILDLIFE SPECIES

Impact Overview

The special status wildlife identified in Table 3.5-4 could be directly affected by construction, drilling, and activities at well sites. These animals may avoid drill locations due to increased noise and human activity in the project area. The waste fluid by-products of project operations could also directly and indirectly harm them.

Impact 4.5-19: Ingestion of Toxins

A small potential exist for animals to ingest chemical toxins from geothermal fluids via:

- bioaccumulation of constituents up the food chain
- consumption of insects or other small prey animals colonizing ponded water in the well pad sumps
- direct ingestion of sump water

Toxins (e.g., chloride compounds) would be present in very low concentrations and would require long-term accumulations to reach potentially harmful levels in the sumps and on the minimal forage vegetation near the well pads. This potential impact is considered to be below the level of significance; however, Mitigation Measure 4.5-10 would further reduce the potential for the impact to occur.

Mitigation Measure 4.5-10. Geothermal fluid ponded in the well pad sumps shall be removed from the sumps within 60 days of discharge to preclude insects from colonizing spent geothermal fluid or toxins accumulating in the sump waters.

Impact 4.5-20: Raptor Activity

Well pad construction or drilling noise and activity at well pads could be sufficient to adversely affect nesting and fledging activities of the raptors, which can be particularly sensitive to these effects. Use of standard noise controls and reduction measures on construction and well drilling equipment by CPN would minimize disturbance of general wildlife in the area. The limited, short-term nature of drilling and testing activities also would reduce this impact to a less than significant level and no mitigation measures are required. Mitigation Measure 4.5-11 would ensure that the adverse effects of the impact would be less than signficant.

Mitigation Measure 4.5-11. Drilling and testing activities shall not be conducted at well pads or proposed well pads within 0.5 miles of any raptor nest sites, during the raptor species' reproductive period, or during periods when the nest is active, in conformance with the Forest-wide Standards and Guidelines (USFS 1991).

Impact 4.5-21: Animal Activity

Noise could disrupt wildlife habitat utilization and behavior patterns. During project construction, there would be activities and noise associated with the falling of timber, road and well pad construction or restoration, and well drilling. Noise from equipment during the operation phase could cause sensitive wildlife to avoid the area. These activities and noise would be of a temporary, short-term nature. Use of standard noise controls and reduction measures on construction and well drilling equipment by the CPN also would minimize disturbance of general wildlife in the area. This impact is considered less than significant; Mitigation Measure 4.5-12 would ensure this insignificant impact level.

Mitigation Measure 4.5-12. Drilling and testing activities shall not be conducted at well pads or proposed well pads within 0.25 miles of any animal denning sites or during the species' reproductive or breeding period, in conformance with the Forest-wide Standards and Guidelines (USFS 1991).

Impact 4.5-23: Hot Sump Fluids

A small number of terrestrial and avian animals that would be attracted to the ponded water in the well pad sumps could suffer injury or mortality from direct exposure to scalding geothermal fluid. This impact is considered less than significant because of the rapid cooling of geothermal fluids in the sumps and the low likelihood of wildlife being present at the sumps during nearby well pad operation. Mitigation Measure 4.5-13 would further reduce this potential effect.

Mitigation Measure 4.5-13. Netting or other protective measures shall be constructed over the fluid storage basins at each of the deep test well sites during periods when geothermal fluid is stored in the basins to discourage bats and other wildlife from attempting to contact or drink from the sump basins. If netting is used, the netting material and mesh size will be sufficient to prevent birds or bats from contacting the contents of the sump but not to trap or harm these animals in the netting itself.

EFFECTS OF ALTERNATIVE B

There would be no adverse effect to biological resources from Alternative B, the "No Action" alternative

4.6 Climate and Air Quality

SIGNIFICANCE CRITERIA

The project would have a significant effect on the environment if it would:

- Violate or contribute substantially to an existing or projected violation of any ambient air quality standard
- Violate any regulatory requirement of the SCAPCD, CARB, or EPA
- Affect the air quality in a Class I airshed within the requirements of the CAA
- Expose sensitive receptors to substantial pollutant concentrations
- Expose the public to objectionable odors
- Substantially alter air movement, moisture, temperature, or local or regional climate
- Create a potential public health hazard

IMPACT OVERVIEW

Typical air quality impacts of geothermal exploration are associated with short-term construction dust, emissions from the operation of diesel-fueled engines, and release of geothermal fluids to the atmosphere during well testing. The first two sources are typical of any construction project involving surface disturbance and use of diesel-fueled engines; the third is unique to geothermal exploration. The assessment of impacts assumes the implementation of those measures incorporated into the project design or required by regulation, which avoid or reduce potentially significant impacts. Appendix F (Fourmile Hill Air Quality Impact Assessment) of the 1998 Fourmile Hill Development project investigates emissions from all possible sources during geothermal development. The analysis below stems from the findings in the Fourmile Hill Air Quality Impact Assessment.

EFFECTS OF ALTERNATIVE A

Construction Emissions

The primary criteria air pollutant of concern during construction of the proposed action would be particulate matter in the form of fugitive dust. During site clearing operations, increased traffic could increase fine particulate emissions. During pad site construction, fugitive dust emissions would occur from construction vehicles and equipment creating dust. Vehicle traffic to and from the drill sites would add to fugitive dust emissions. Wind erosion is not expected to occur due to the surrounding trees that serve as windbreaks and the relatively compacted surfaces of the roads and well pads (which have generally been sited on previously disturbed areas).

As discussed in previous air quality analyses (BLM et al 1995, BLM et al 1998), air quality effects from construction activities at the well sites and access roads would be localized and temporary. Construction activities would increase short-term particulate matter concentrations in the vicinity of each well site (lasting one to two weeks for TGH pads, and about 30-days for exploration pad construction). The increased concentrations would be localized and would not create a significant affect on air quality in the project area. The

pads and roads would be watered to reduce dust; the effects would not be significant. Mitigation for fugitive dust is discussed in detail under *Criteria Pollutants*.

Drilling and Flow testing

Emissions would occur during well drilling and testing at the proposed action sites. The primary source of criteria air pollutants during drilling would be from equipment and machinery operating at the well sites, as well as vehicles associated with the drilling activities. There would be a limited amount of equipment and vehicles located at the well sites, and the volume of emissions from these sources would be low. Shortening drilling periods can reduce impacts related to diesel engine exhaust during drilling. CPN anticipates a 45-day drilling period for each well and would endeavor to minimize the length of drilling. In addition, all engines, gas and diesel, would be maintained in good and serviceable condition to minimize exhaust gasses. Motorized vehicles would be restricted to designated established roads.

Site 64-27 TGH. There would be no geothermal emissions from drilling of the TGH at site 64-27. The hole would not reach the geothermal resource during drilling. The hole would be drilled exclusively for determining downhole temperature gradients. No air pollution control equipment is proposed for this short-term drilling program because there would be no emissions from the hole. The engines would operate on California #2 diesel, which has been demonstrated by CARB to produce lower particulate matter, sulfur oxides, and nitrogen oxides emissions than #2 diesel sold in other states. The drill rig and associated equipment would not produce emissions of any pollutant in excess of the SCAPCD's New Source Review threshold. In order to ensure that this is the case, CPN proposes to limit the maximum daily consumption of diesel fuel to 300 gallons. Appendix G provides the emissions calculations for the three engines. Table 4.6-1 displays the estimated emissions for the engines used in drilling the TGH.

Table 4.6-1: Maximum Hourly Fuel Use and Emissions[1]

Engine	Rated Horsepower	PM_{10} (lb/hr)	NO_X (lb/hr)	SO_X (lb/hr)	CO (lb/hr)	TOC (lb/hr)
Detroit 12V-71N	410	0.902	13	0.84	2.74	1.0
Deutz F2L1011F #1	29.5	0.065	0.91	0.060	0.197	0.07
Deutz F2L1011F #2	29.5	0.065	0.91	0.060	0.197	0.07
Total	469	1.0	14.5	0.96	3.13	1.2

[1]Based on continuous use at rated horsepower
SOURCE: Calpine 2002 (ATC permit application)

Sites 64-27 and 85-33 Deep Exploration Well Drilling

Drilling Rig Engine Exhaust. A large drilling rig would drill the two deep exploration wells. Typical diesel-electric SCR drilling rigs have three 910 brake horsepower (hp) diesel engines operating 800 kW 0.8 power factor generators, and two triplex mud pumps each driven by two electric 752 hp traction motors. The rig's engines are registered under the California Air Resources Board Portable Engine Program and must meet the conditions of

those permits (Appendix H). Estimated emissions of pollutants typical of this type of diesel engine use are summarized in Table 4.6-2. Table 4.6-2 describes diesel exhaust from engines that were described in the 1998 Fourmile Hill EIS/EIR. The CARB registered engines have emissions factors less than or equal to those listed below.

Table 4.6-2: Diesel Exhaust from Drilling Rig Engines

Pollutant		Emission Factor (lb/hp-hr)	Emissions lb/hr	lb/day	Ton/year
NO_x[a]	Uncontrolled	0.024	40.8	979.2	39.6
	Controlled	0.013	22.1	530.4	21.4
CO		0.0055	9.35	224.4	9.0
SO_x[b]	Uncontrolled	0.00809	13.8	330	13.2
	Controlled	0.000405	0.69	16.5	0.66
PM_{10}[c]		0.0007	1.19	28.6	1.14
VOC[d]		0.000705	1.20	28.8	1.15

Notes

Data presented in the above table is from the emissions outlined in the Fourmile Development Project. The rig to be used in the proposed program would have newer engines that would be equal to or less than those presented as required by CARB.

Lb./day = lb./hr. x 24 hr./day

Ton/year = (hp x lb./hp-hr x 24 hr./day x (80 days/well x 2 wells)/2000 lbs./ton where hp = (average drill rig engine output over the duration of drilling one well)

[a]NOx Controlled emission factor based on ignition timing retard.

[b]SOx emission factor = 0.00809 based on 1% sulfur in diesel fuel. Controlled emission factor based on low sulfur fuel. Uncontrolled factor x 0.05 (wt % S in low sulfur fuel) = 0.000405.

[c]PM_{10} based on emission factor for total particulate

SOURCE: BLM et al 1998

Arnica Sink Water Well. A small portable diesel engine would be used at the Arnica Sink Well to pump water into water pipelines. The water pipelines would deliver water to the deep exploration well sites for flow testing. The portable engine is a registered CARB engine and exempt from a district permit. Because emissions from the engine would be intermittent and temporary they would not create a significant effect on the air quality surrounding the water well. The portable engine registration and applicable CARB conditions are included in Appendix I.

Sites 64-27, 85-33, 68-8, 31-17, and 87-13 Flow Testing. Flow testing the exploration wells would have the potential to release geothermal steam to the atmosphere. CPN anticipates that the geothermal fluid produced during the flow tests would consist of a two-phase

mixture of steam and brine. Brine can be defined as a liquid solution containing elevated levels of sodium chloride and other salts. The mixture would flow through a separator that separates the steam and brine to separate pipelines where it can be metered. The steam is then sent to an atmospheric flash vessel or silencer to be released into the atmosphere. The steam produced from existing Glass Mountain geothermal wells has characteristically contained very low concentrations of non-condensable gases (BLM et al 1995). The steam phase contains noncondensable gases such as hydrogen sulfide, ammonia, methane, arsenic, and usually 95-98 percent carbon dioxide. Brine typically contains the metals, boron, and other water soluble or particulate pollutants. The liquid brine would flow to a sump on-site prior to injection back into the geothermal reservoir via another existing well. The impacts of flow testing will also be reviewed by the SCAPCD in its review of the CPN application for an Authority to Construct (ATC) permit for the proposed wells.

Hydrogen sulfide (H_2S). 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; BLM et al 1998). The primary emission of concern during the proposed action would be hydrogen sulfide (H_2S). Hydrogen sulfide is produced in nature primarily through the decomposition of organic material by anaerobic bacteria. H_2S develops within stagnant anaerobic areas such as swamps, and naturally as a constituent of natural gas or petroleum. H_2S is a colorless, flammable and toxic gas that has a noxious odor. At first contact the odor smells like rotten eggs, however the sense of smell is lost after 2-15 minutes of exposure making it difficult to detect dangerous concentrations. Small quantities of hydrogen sulfide may escape during drilling or flow testing.

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. The SCAPCD has established a limit of 10 pounds per hour for the release of H_2S from a geothermal well source (SCAPCD 2002). During normal operations hydrogen sulfide hazards are minimized because the gas is neutralized in the drilling mud, and 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 below the emission threshold established by the SCAPCD. Well drilling and testing under the POO would be expected to result in approximately 3.75 pounds per hour of H_2S emissions.

There is the potential that H_2S odors would occasionally be detectable in the vicinity of the well pads during testing; however, 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.

The air quality and mitigation required during drilling and flow testing are thoroughly evaluated in the 1998 Fourmile Hill EIS/EIR, the 1995 Glass Mountain Unit EA/IS, and the 1999 Telephone Flat EIS/EIR, and are fully incorporated herein. The incorporation into the project of the following Best Management Practices, permits, Fourmile and Telephone Flat mitigation measures, and adherence of relevant agency guidelines reduces potential impacts to less than significant.

To further ensure that there would be no H_2S effects from well drilling and testing, CPN would monitor H_2S concentrations at the drill site during drilling and flow testing. During drilling, the mudlogger would monitor for H_2S constantly. The results of the monitoring would be submitted to the district weekly.

H_2S concentrations emitted during drilling and produced in the geothermal fluid and preliminary flow would be measured during flow testing. The mud logger would monitor the fluids produced and drilling rig alarms on the floor would be triggered at 10 ppm at which time the appropriate safety precautions would be taken. Once the well is drilled and flow testing commences, the wells would be sampled weekly and data reported. During both drilling and flow testing, employees would wear toxiclip monitors and would report the ambient data at the site to the air district upon request. Workers would also be equipped with alarms to indicate H_2S concentrations approaching 10 ppm. Respirators would be available at each drill rig.

If H_2S measurements suggest that the H_2S emissions approach the levels of adversely effecting air quality or presenting a safety hazard, chemical abatement (such as NaOH) may be utilized depending on the emissions expected at a given well and the vicinity to nearby receptors. The standard abatement process for the geothermal industry is to inject chemicals into the discharge line to neutralize the gas. A trailer-mounted abatement skid with chemical totes for NaOH, a pump, and appropriate monitoring equipment will be kept on site, and the discharge line would be appropriately valued to provide for abatement at any time if needed. Blow out prevention will be performed in accordance with GRO Order No. 2 and industry standard drilling practices.

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, if they occurred (BLM et al 1995). The flowtest would not be subject to New Source Review, and would not trigger any significant levels found in Rule S4.

Criteria Pollutants. The proposed action would not increase concentrations of pollutants in excess of air quality standards. If necessary, the diesel exhaust emissions from the drill rig engine would be controlled as provided by their CARB permits. At each engine, injection timing retard shall be used to control NO_X emissions, low sulfur fuel shall be used to control SO_X, and the engines shall be turbocharged and aftercooled.

Table 4.6-3 lists proposed emissions produced from geothermal exploration. The table assumes emissions from three wells at the same time (BLM et al 1998), producing a worst-case scenario for the proposed action. The proposed action would only produce emissions from one well at a time. The emissions are representative of what type of emissions could be released into the local airshed of the proposed action. The 1998 Fourmile Hill EIS/EIR and the 1999 Telephone Flat EIS/EIR address maximum annual average concentrations of criteria pollutants at adjacent receptors for comparison.

Table 4.6-3: Maximum Daily Emissions of Criteria Pollutants (lbs/day)

	CONSTRUCTION[a]		
Criteria Pollutant	**Fugitive Dust[b]**	**Drill Rig Engines**	**Venting Wells**
PM_{10}	107	86	16
Hydrogen Sulfide	0	0	38
Lead	0	0	$1.0x10^{-4}$
Nitrogen Oxides	0	1,591	0
Sulfur Oxides	0	50	0
Carbon Monoxide	0	673	0

Notes:

[a] Construction emissions are based on the third year of construction at the wellfield and power plant, which represents the worst-case conditions. Emissions during the first and second years would be less as a result of reduced drilling activities. See Appendix F of the 1998 Fourmile Hill EIS/EIR, Tables 6 through 11, for maximum daily construction emissions for each of the three years of construction.

[b] Fugitive dust emissions are based on EPA emissions factors and equations for earthmoving activities and travel on unpaved and paved roads. The emissions are also based on the assumption that the proposed dust abatement program would reduce emissions by 50%. The fraction of fugitive dust that would be composed of PM_{10} would be approximately 50%.

SOURCE: Precise Environmental Consultants and MHA Environmental Consulting, Inc. 1997.

Good operating practices would be used to minimize particulate emissions. CPN would perform dust suppression on access roads and drill sites according to USFS requirements, in order to minimize fugitive dust emissions. Dust suppression would include watering, adding dust palliatives (i.e. Magnesium chloride), or surfacing active construction areas and access roads where soil disturbance would occur. The amount of watering would depend on the soil moisture content, weather conditions, and as approved by the USFS, the BLM, and the SCAPCD. In addition, all construction vehicles would be limited to 25 miles per hour or less on all unpaved roads, and all construction trucks hauling loose materials would be covered at all times.

Construction, drilling, and venting would not occur simultaneously and would not produce a cumulative effect. Good management practices, abatement, and mitigation would also reduce the cumulative effect of diesel, dust, H_2S, and well emissions occurring at the same time.

Class I Areas. The Lava Beds National Wilderness area is the only Class 1 area closest to the two proposed well drilling sites. A Class 1 area is an area regulated with the strictest air resource standards. The Lava Beds area is approximately 3 miles northeast of the Fourmile Hill well sites and approximately 6 miles north of the Telephone Flat well sites. A natural ridgeline runs east to west forming a barrier between the Telephone Flat sites and the Lava Beds area. In addition, winds naturally blow from the northwest to the southeast further dispersing project emissions. The proposed action would therefore not have an adverse effect on Class 1 areas in the vicinity of the proposed action.

Conformity Analysis. All proposed federal actions must comply with the EPA rule on "Determining Conformity of General Federal Actions to State or Federal Implementation Plans" (40 CFR 93, Subpart B). This regulation requires that an analysis of the conformity of the proposed federal action be prepared in federal nonattainment or maintenance areas for each pollutant for which the project area is designated as nonattainment or maintenance area, if the project emissions exceed thresholds listed in the regulation. The emissions analysis for this document is based on estimates prepared for the 1998 Fourmile Hill EIS/EIR (see Appendix F of the Fourmile EIS/EIR). The emissions estimates indicated that the emissions of all pollutants are expected to be below the thresholds listed in the regulation for nonattainment or maintenance areas and would not be regionally significant. No further conformity analysis is required.

MITIGATION MEASURES

All mitigation has been included as part of the proposed action therefore no extra mitigation is required.

EFFECTS OF ALTERNATIVES B (NO ACTION)

The "No Action" alternative would increase reliance on fossil fuels to produce energy. In the United States, 55% of the electricity comes from the burning of coal. The purpose of the action is to develop cleaner renewable energy sources such as geothermal .

4.7 Noise

SIGNIFICANCE CRITERIA

Part 11.C of GRO Order No. 4 states that noise levels from a geothermal operation at 0.5 mile (2,640 feet) or at the lease boundary, whichever is greater, shall not exceed 65 dBA. This level on a 24-hour basis is equivalent to approximately L_{dn} 72. There are no other Federal noise standards or Forest Management Plan guidelines that are used by the Klamath and Modoc National Forests in addressing and evaluating noise.

A noise effect would be considered significant if the level of noise from operation equals or exceeds 65 dBA at the lease boundary, or 0.5 miles from the source, whichever is greater.

EFFECTS OF PROPOSED ACTION

Pad and Road Construction Noise

Estimates of noise levels from construction of a typical well pad assumed an equipment assemblage which included one large bulldozer, one scraper, a large diesel truck, and one cement truck or crane. It was also assumed that, on average, each piece of equipment would generate a maximum noise level of about 83 dBA at a distance of 50 feet one-half of the time and would operate at idle the other half.

Estimated noise levels at various distances from pad and access road construction are shown on Table 4.7-1; estimated noise octave and spectra from these activities are presented in Table 4.7-2. Noise from construction activities would be temporary in nature and would occur for very short durations (one to two weeks at TGH well sites and 30 days at the larger exploration pads). 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 at sensitive receptors. The nearest sensitive receptors are the campgrounds and summer cabins around Medicine Lake, which is about 2 miles away from the closest pad proposed for construction (85-33).

Pad and road construction noise would be produced at wells 64-27 and 85-33. The proposed well pad site 64-27 is off the main road down an old skid road. The access road requires some widening and clearing to allow large trucks access to the location. No other road improvements would be required by the proposed action. Preparation of the 64-27 and 85-33 sites for drilling would involve expanding (clearing) the well pad areas.

Table 4.7-1: Typical Noise from Geothermal Exploration Activities

	Noise Level (dBA)[1]					
Activity	**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: Glass Mountain Unit Geothermal Exploration Project 1995

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

		Octave Band Center Frequency (cps)[2]								
Activity	**Distance in Feet**	**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
Flow testing: min	150	68	75	85	91	91	91	86	86	76

Notes:

[1]Estimated noise spectra is expressed as sounds 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: Glass Mountain Unit Geothermal Exploration Project 1995

The noise-sensitive receptors closest to the proposed well pads to be constructed are the summer residences and campgrounds located near Medicine Lake. These recreational facilities are located almost 3.5 miles (18,480 feet) from well pad 64-27 and almost 2 miles (10,560 feet) from well pad 85-33. 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 receptor sites would be expected to be lower than 65 dBA due to the sound-muffling properties of the Forest.

Since noise construction 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 therefore would not adversely affect noise-sensitive receptors in the vicinity of nearby campgrounds and residences.

A forest visitor driving past the well sites (on Primary Forest Route 49 approximately 850 feet from the project vicinity) during construction, including well drilling, would likely hear noise levels of approximately 62 dBA. A hiker or hunter passing in close proximity (between 200 to 400 feet away) to the well sites during construction would hear higher noise levels, ranging from 73 to 68 dBA, respectively, depending upon the actual distance from the sites. Noise from steady drilling sounds like a low-frequency hum or a "rushing" sound. These sounds are not expected to be particularly annoying to people. The clanging of drill pipes and high-pressure air releases are expected to be audible and possibly annoying to forest users, depending upon their location.

Construction noise associated with well 64-27 and 85-33 construction could result in short-term adverse impacts if users of forest lands are exposed to construction noise. Construction activities, however, would not exceed the GRO noise limit. Typical forest visitors (hikers and hunters) may come in close proximity to the well sites and therefore would be exposed to construction noise on a temporary basis. Noise levels during construction would not endanger the hearing of forest visitors in these areas, nor would they occur during noise sensitive periods such as night.

Traditional Cultural Properties (TCPs) within the KGRA may potentially be affected by construction, drilling, and flow testing noise. Noise impacts on TCPs are discussed in Section 4.4 Cultural Resources.

Pipeline Installation Noise

The proposed project would include installation of a pipeline to supply freshwater to the drilling locations (sites 64-27 and 85-33) and to carry produced geothermal fluids to injection wells in both the Fourmile Hill and Telephone Flat areas. The pipeline routes are shown in Figure 2.2-10.

The pipeline would be laid by hand through the forest as necessary. Equipment or vehicles would be used where possible for installation of the pipeline along the roadway. The pipeline installation would take from 1 mile per week to 2 miles per week for roughly 9 miles of pipeline.

Pipeline installation and removal would not cause significant amounts of noise at the nearby campgrounds and residences (1.5 miles away from the nearest well pad, 87-13). Noise from the pipeline installation and removal may be encountered by forest travelers, hikers, or hunters who may pass through the pipeline vicinity. The effects to Forest visitors would be brief (for the minute or so passing the activity) and short-term (about five to eight weeks).

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.

Well Drilling Noise

The drilling rig would be diesel-electric powered, using three diesel-powered engines. Drilling any well is assumed to require 45 to 60 days. Well drilling and venting are 24-hour operations. In addition, it is assumed that drilling noise is at an elevation of 40 feet above the local ground or well pad elevation. Estimated noise levels, octaves and spectra at various distances from well drilling activities are shown on Table 4.7-1 and 4.7-2. Drilling noise and equipment operations would be limited in duration.

Monitoring would be done during drilling operations at the homes at the southeast end of Medicine Lake and the North Campgrounds (Receptor Sites 1 and 2 respectively) to confirm compliance with Federal standards. Site and equipment specific noise control measures would be implemented if necessary to stay below these requirements.

Fourmile Hill Area. Well site 64-27 is proposed for a TGH and deep well exploration location. The TGH would take 30-45 days to drill. A deep well is also proposed for 85-33; the deep wells would take 45-60 days to drill (Wardlow 2002, pers. comm.). Depending on summer 2002 results from other drilling operations, pad 64-27 could be cleared and constructed in the late summer or early fall to drill a TGH and/or a deep well in late 2002 or in the spring of 2003.

Due to the nature of well drilling noise, it is more likely to be audible and potentially disturbing than the other construction noise sources. Well drilling noise at the various receptors around Medicine Lake, if two wells are drilled simultaneously, is estimated to be in the 20 to 26 dBA range, which is significantly lower than the GRO standard of 65 dBA and generally below ambient noise levels (see Table 3.7-2 in Section 3.7). An evaluation of octave band noise levels from drilling was conducted (in 1996 for the Fourmile Geothermal Development Project EIS/EIR) to determine whether such noise could be audible and potentially disturbing. Calpine proposes to drill only one deep well at a time, thus noise impacts would not be significant.

The octave band noise level evaluation was conducted selecting well sites at high elevations of about 6,500 feet and 6,800 feet, where there was less chance of noise emissions to be affected by noise barriers of the terrain. Table 4.7-3 shows the octave band noise levels, in dB, and the overall noise levels in dBA, estimated if wells at the selected sites were drilled and vented simultaneously.

Table 4.7-3: Estimated Sound Levels from Well Drilling at Selected Receptor Locations[1]

Location of Receptor	Octave Band Center Frequency (in dB)								Overall in dBA L_{eq}
	63 Hz	125 Hz	250 Hz	500 Hz	1 Khz	2 Khz	4 Khz	8 Khz	
1. North Campgrounds	41	39	27	8	0	0	0	0	25
2. Homes at southeast end of Medicine Lake	39	36	25	5	0	0	0	0	22
3. Homes and picnic area near Little Medicine Lake	40	36	25	6	0	0	0	0	22
4. Schonchin Picnic Area[2]	42	40	29	11	0	0	0	0	26
5. Home at southwest end of Medicine Lake[2]	38	34	22	2	0	0	0	0	20

Notes:

[1] Estimated sound levels are for drilling wells at pads P-1 and P-2 of the proposed Fourmile Geothermal Development Project. These wells are located about 1.5 miles east of the proposed pad 64-27.

[2] Octave band frequencies are also provided for the Schonchin picnic area, just north of Little Medicine Lake, and for the home at the southwest end of Medicine Lake. This information is based on ambient noise levels and octave band levels as measured at receptor site 3, near Little Medicine Lake, which are representative of these other two locations.

SOURCE: Fourmile Hill Geothermal Development Project EIS/EIR 1997

As indicated in Table 4.7-2, estimated octave band noise levels during well drilling activities would not produce audible sounds in the 1,000 (1 Khz, or kilohertz) to 8,000 (8 Khz) bands. These bands are the frequencies to which the human ear is most sensitive The air molecules absorb (much like a sponge absorbs water) most of the acoustical energy at these frequencies.

Comparing these octave band levels to ambient levels shown in Table 3.7-3, illustrates that the estimated octave band levels from drilling noise are almost uniformly lower than or just about equal to the ambient levels. The octave bands of drilling noise do not show any "peaks," (i.e., bands that are 5 to 10 dB higher than the two adjacent bands). It is unlikely that people near Little Medicine Lake and Medicine Lake would usually be able to hear drilling noises.

Typical forest visitors (hikers and hunters) that may come in close proximity to the well sites would mostly be in these areas for relatively brief periods of time and therefore would be exposed to testing noise on a temporary basis. Additionally, noise levels during drilling would not endanger the hearing of forest visitors in these areas.

Telephone Flat Area. There are no proposed drilling activities at well pad sites 86-8, 31-17, and 87-13. No noise impacts related to well drilling would occur at the proposed sites within the Telephone Flat area.

Flow Testing Noise

Estimated noise levels at various distances from exploration well testing activities are shown on Table 4.7-1. TGH wells would not be tested as they would not be drilled to reach the geothermal reservoir. Well testing would only occur at exploration wells. Testing at existing wells in the Fourmile area would begin after drilling in the summer of 2002 and would last up to 30 days. Testing at existing wells in the Telephone Flat area would begin in July 2002 and would last up to 30 days each.

Monitoring would be conducted during flow test operations at the homes at the southeast end of Medicine Lake and the North Campgrounds (Receptor Sites 1 and 2 respectively, see Table 3.7-2) to confirm compliance with Federal standards. Site and equipment specific noise control measures would be implemented if necessary to stay below these requirements.

Ambient noise levels in the immediate vicinity of the well pads would increase during well testing activities. These increases would only occur during testing and would be temporary in nature. As shown in Table 4.7-1, noise levels at the Medicine Lake and Bullseye and Blanch Lake areas from testing activities would be below the threshold of 65 dBA. Monitoring would be conducted at the southeast end of Medicine Lake and the North Campgrounds, and site and equipment specific noise measures would be taken to comply with noise level standards.

Typical forest visitors (hikers and hunters) that may come in close proximity to the well sites would likely be in these areas for relatively brief periods of time and therefore would be exposed to testing noise on a temporary basis. Noise levels during testing would not endanger the hearing of forest visitors in these areas.

Noise Effects on Animal Species

Estimated noise and octave spectra from geothermal exploration activities are shown in Table 4.7-2. During exploration activities, some animals may avoid habitats in the vicinity of the proposed project due to the increased noise levels, particularly if a species is sensitive to a frequency range that the various geothermal exploration activities would generate. Proposed activities would be sporadic and temporary in nature. Any avoidance of habitats in the vicinity of the proposed project by wildlife species would also be temporary, and therefore not significant.

MITIGATION MEASURES

Mitigation Measure 4.7-1

Muffler systems shall be used on all heavy equipment during construction, drilling, and testing activities.

Mitigation Measure 4.7-2

If air drilling is conducted, a cyclonic separator/muffler would be employed to reduce drilling noise.

Mitigation Measure 4.7-3

Pad site and access road construction activities would be limited to daytime hours (typically 7:00 a.m. to 7:00 p.m.) to minimize nighttime noise impacts.

EFFECTS OF THE NO ACTION ALTERNATIVE

There would be no noise effects from implementation of the No Action alternative.

4.8 Visual Resources

SIGNIFICANCE CRITERIA

In accordance with CEQA Guidelines, project impact would be considered significant, and therefore subject to feasible mitigation, if the exploration activities would have the potential to:

- Alter scenic vista as noticeable from identified vantage points
- Have a substantial adverse effect on a scenic vista
- Substantially degrade the existing visual character or quality of the site and its surroundings
- Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway
- Create a new source of substantial light or glare, which would adversely affect day or nighttime views in the area

For the purposes of this analysis, a substantial effect on the scenic resources and characteristics mentioned above would be changes to these resources and characteristics that are immediately perceivable by sensitive receptors in the project vicinity.

In accordance with USFS visual assessment practices, visual quality impacts would also be considered significant if:

- A project condition results in a long-term inconsistency with established USFS Visual Quality Objectives (VQOs)
- The project would create a high level of visual contrast as related to spatial characteristics, visual scale, texture, form, line, and color as viewed from Key Observation Points (KOPs)
- The project and proposed mitigation measures would not meet a Retention and Partial Retention VQO within three years of project completion

In accordance with the National Park Service (NPS) visual resource policies, if any visual intrusion related to the proposed project would be perceived by visitors in the Lava Beds National Monument's two wilderness areas, the quality of the wilderness would be adversely affected.

METHODOLOGY

Project effects on regional visual resources are evaluated by KOP or by KOP groupings that are located in a particular area. There are several instances where views from forest roads, which are not identified KOPs, are also evaluated due to their proximity to the proposed action.

The Fourmile Hill Geothermal Development Project EIS/EIR and Geothermal Exploration Project EA/IS included an evaluation of KOPs in the vicinity of that proposed project[1].

[1] Respective methodologies for establishing and evaluating KOPs are discussed with the Fourmile Hill Geothermal Development Project EIS/EIR, the Fourmile Hill Geothermal Exploration Project EA/IS, and the Telephone Flat Geothermal Development Project EIS/EIR.

Also, potential KOPs were evaluated and discussed in the 1999 Telephone Flat Geothermal Development Project EIS/EIR. Because the proposed project would occur in the vicinity of these pervious study areas, the same KOP evaluations are used for the purposes of this analysis. KOPs for the proposed project are presented in 3.8 Visual Resources.

Project effects on regional visual resources are also evaluated based on the project area's USFS-designated Visual Quality Objective (VQO), in addition to CEQA thresholds outlined above. The VQOs for the areas in which the proposed well pads are located are presented in Table 3.8-2.

EFFECTS OF PROPOSED PROJECT

Fourmile Area

Visual simulations of proposed action facilities and facilities that would occur with proposed project were prepared for 3 of the KOPs identified in Table 3.8-1. The 3 KOPs were selected based on input from the Lava Beds National Monument staff, the Modoc and Klamath National Forest staff, and the public during the public scoping period for the Fourmile Hill Geothermal Development Project EIS/EIR. These KOPs are intended to provide a range of view perspectives of the proposed action and alternatives from key public viewing locations within the study area, and include:

- Primary Forest Route 49/Medicine Lake Overlook
- Primary Forest Route 97
- Lava Beds National Monument/Schonchin Butte

Vehicle and Equipment Traffic. The temporary visual effect of vehicles and equipment on forest roads during project activities would be a short-term adverse, but not significant visual impact. The temporary visual effect of vehicles and equipment on forest roads during operation would not result in significant visual impacts.

Construction employee vehicles and construction vehicles and heavy equipment would be present on forest roads, primarily during the spring and summer months of 2002. As described and evaluated in section 4.11 Transportation, project activities would result in a temporary increase in vehicular traffic in the vicinity of proposed well pads 64-27 and 85-33. Construction employee and vehicle access is proposed from the northwest via Forest Routes 15, 77, and 49 (see Table 2.1-1). Proposed routes from the south are via Highway 89 to Forest Route 15 to 77.Road use permits would be obtained from the Doublehead and Goosenest-USFS district offices prior to the commencement of operations.

The visibility of temporary construction vehicles and equipment would be a short-term adverse impact.

Construction. During the day, on-the-ground construction at well pad 64-27 would not be fully visible from Forest Route 49, which is about 850 feet east of the well pads. Intervening forest cover would likely shield the view of the majority of activities. Construction at well pad 85-33 would be visible from Forest Route 77 as the site is located just west of the road. It is not anticipated that construction at pad 85-33 would be visible from Forest Route 49. The well pad sites are physically separated from the Medicine Lake area by forest and by major topographic features, including the Medicine Lake Caldera.

Construction of well pads 64-27 and 85-33 would result in short-term adverse visual impacts from Forest Roads 44N54 and 44N64. This impact would not be significant because the visibility of construction activities would not result in long-term inconsistencies with VQOs. Construction activities would be temporary and the duration of views from these roads would not be more than fifteen to thirty seconds as they would be seen primarily by passing motorists. Such views would not impact the overall visual characteristics of the vicinity.

Expansion of the well pads during construction would slightly alter the visual character of the sites, which have been previously disturbed. Further disturbance of the site would not create a significant effect on scenic vistas from identified vantage points and KOPs would remain surrounded by forest cover.

Pipeline Installation. The proposed pipeline would create a visual impact along its route. The pipeline would be located along existing roads and would thus be visible to travelers along those roads. The pipeline would be temporary and would therefore not have a significant effect on the visual quality of the area. The pipeline would not be visible from any KOP.

Drill Rig Mast Lighting. Drill rig lighting would be along the full length of drill rig masts, anticipated to be 140- to 145-feet tall. Drill rigs are typically operated on a 24-hour basis when in use. Only one drill rig at a time would be in operation. An example of a TGH drilling rig is shown in Figure 2.2-3. Specifications of the lighting would be as follows:

- Sixteen to 18 florescent rig lights, each with two 34-watt bulbs, spaced about 15 feet apart from the rig floor to the crown, pointed in and down
- Six to eight mercury vapor lights, each with one 400-watt bulb, placed on wind walls around the floor, pointed in and down
- Six to eight mercury vapor light in the sub bases pointing at the Blowout Prevention Equipment (BOPE)
- One red crown light with a 100-watt bulb, possibly flashing (required by law for airplanes)

The density of the forest canopy and average tree height (45 feet) would cover most of the lighting but would not be sufficient to block drill rig lighting along the full length of the masts. At night, drill rig mast lighting, when in use at well pads 64-27 and 85-33, would be visible along Forest Route 49. Lighting along the drill rig masts would also be visible in the foreground along Forest Roads 44N54 and 44N64 by passing vehicles. The light would be seen briefly by night travelers along these roads. Upper portions of the drill rig mast would create a glow that would be visible from the Little Mount Hoffman Lookout Station, and the top of Schonchin Butte and Captain Jacks Stronghold KOPs situated within the Lava Beds National Monument (see Figure 3.8-1).

The lighting would create an inconsistency with the VQO of Retention, which covers the well pad sites in the Fourmile Hill area (64-27 and 85-33). As previously stated, adverse impacts would also occur on views from the Lava Beds National Monument. This lighting would be minimized by facing the lights inward and down. Views from vantage point at Little Mount Hoffman and the Lava Beds National Monument would be a faint glow against an immense, dark backdrop up to over 7,500 feet in elevation. This impact is considered less than significant.

Flow Testing. 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. The average forest cover is 45 feet tall. The presence of flow testing equipment would not have a significant impact. During flow testing, a steam plume would be produced. A discussion of impacts from the steam plume is provided below.

Well Venting Steam Plumes. Well venting for flow testing would occur once well drilling is completed for a particular well. Venting and testing would last as long as four weeks. Steam plumes would be visible during testing. The height of well venting plumes could range from 40 feet during hot summer days, to 285 feet during the winter.

The size and visibility of steam plumes are primarily related to ambient temperature and the resulting significant differences in evaporation rates. On hot, dry days with high evaporation rates, steam plumes may not be visible because higher ambient temperatures result in plumes that are less dense (opaque) and less visible. Steam plumes are typically most evident on cold days with lower evaporation rates, resulting in plumes that are more dense and, therefore, more visible. Regardless of the ambient temperatures, variations in atmospheric pressure and wind conditions can make the visibility of steam plumes ephemeral, due to dispersion.

The visual analysis assumes that the visibility of steam plumes would not result in potential long-term inconsistencies with USFS VQOs because the effects will be intermittent and temporary. Many forest visitors and residents may not readily distinguish steam plumes from clouds or other atmospheric features that may be experienced in the Medicine Lake area. These include clouds, fog emanating over the lake, regional fog and low cloud cover, rain squalls and storms, and snow storms during winter.

It is possible that the steam plume would be visible from Little Mount Hoffman, from KOPs within the Lava Beds National Monument, Forest Routes 49 and 77, and possibly other isolated vantage points.

Telephone Flat Area

Vehicles and Equipment Traffic. Table 2.1-1 presents proposed routes for transporting equipment to and from well pads 68-8, 31-17, and 87-13. Routes would run primarily from Highway 89 at Bartle to Forest Routes 15, 49, and 97. Road permits would be acquired from the USFS Doublehead and Goosenest Ranger District offices. Impacts would be temporary and thus less than significant.

Pipeline Installation. The proposed pipeline would create a visual impact along its route. Pipelines would be installed along existing roads, and would thus be visible to travelers along those roads. The pipeline would be temporary and would not have a significant effect on the visual quality of the area. The pipeline would not be visible from any KOP.

Flow Testing. 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. The greatest visibility for flow testing equipment would be from pad 68-8 as seen by travelers along Forest Road 43N53 since the pad is just east of this road and there are few trees to cover the site. Well pads 31-17 and 87-13 are covered by surrounding trees. Impacts on visibility from nearby roads would be less than significant because they would

be temporary and would be seen briefly by passing motorists. Impacts at distances beyond these roads would also be less than significant because the average forest cover (45 feet tall) would cover the equipment. During flow testing, a steam plume would be produced.

Well Venting Steam Plumes. As stated above, steam plumes will not have a significant effect during the summer months, when plume height would be minimized. Flow testing for pads 68-8, 31-17, and 87-13 is proposed to start in July 2002 and would last up to 30 days per well and thus be completed before winter. Assuming this schedule is followed, impacts for the steam plumes produced at well pad sites 68-8, 31-17, and 87-13 would be less than significant.

MITIGATION MEASURES

Mitigation Measure 4.8-1

To the extent practical, all lights used to illuminate drill sites shall be shielded from identified vantage points to reduce the visual impacts from lighted drill sites during well drilling and flow-testing activities.

Mitigation Measure 4.8-2

Well venting shall be conducted to minimize the size and visibility of steam plumes and will include directing geothermal fluids from the wellhead to a portable silencer, allowing for minimization of particulate matter.

EFFECTS OF THE NO ACTION ALTERNATVE

There would be no visual quality effects from implementation of the No Action alternative.

4.9 Land Use

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 and Klamath National Forests). 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

EFFECTS OF ALTERNATIVE A

Existing Land Uses

The proposed action would not be expected to conflict with existing land uses in the vicinity. Development of the TGH and deep well exploration well pads would be a continuation of the existing geothermal exploration that has occurred in the vicinity of Medicine Lake over the last 22 years. The proposed action would not be expected to conflict with American Indian uses in the vicinity (see Section 4.4, Cultural Resources and Traditional Cultural Values).

The proposed action would occur on relatively small sites (2 sites of approximately 3 acres each) within the Modoc and Klamath National Forests. Since the well pads would be dispersed throughout the forests, 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 areas.

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 4.9.3, Recreation.

Consistency with Plans

Lease Stipulations. The proposed action would be consistent with the lease stipulations for Federal Geothermal Leases CA-1230, CA-6111, CA-12371 and CA-12372. Only the lease for well pad 87-13 (CA-12371) contains a stipulation regarding impacts on recreational uses (see Table 4.9-1 or Appendix C). The stipulation prohibits occupancy of the specified portion of the lease area if the proposed Plan of Operation would result in significant impacts on ongoing recreational uses. As discussed in this section under 4.9.3, Recreation,

implementation of the proposed Plan of Operation would be a short-term temporary effect that would not significantly affect recreational uses in the area.

Klamath National Forest Land and Resource Management Plan. The proposed action would be consistent with the policies and management direction contained in the USFS *Klamath National Forest Land and Resource Management Plan* (USFS 1995). The plan outlines policies and management directives regarding land management designations, released roadless areas, geothermal development, utility corridors, road development, special status species, visual resources, air quality, cultural resources, and American Indian rights (for more detail see BLM et al 1998).

Modoc National Forest Land and Resource Management Plan. 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 1991). The plan outlines policies and management directives regarding released roadless areas, geothermal development, utility corridors, road development, cultural resources, visual resources, and water resources (for more detail see BLM et al 1998).

Mitigation Measures

The effects of the proposed action would be less than significant. No mitigation is required.

EFFECTS OF ALTERNATIVE B

There are no adverse effects on land use from Alternative B, the "No Action" alternative.

4.10 Recreation

SIGNIFICANCE CRITERIA

The CEQA Guidelines identify the following as normally having a significant effect on the environment:

- Conflict with established recreational...uses of the area.

The following significance criteria were developed to determine if the Project effects on recreational resources could potentially be significant based on information from USFS documents, concerns expressed during public scoping, and comments made regarding similar projects in the vicinity. The project effects on recreation resources would be considered significant if:

- The location of proposed geothermal facilities would significantly alter regional recreational use patterns and/or preclude existing recreation uses from taking place in the region;
- An inconsistency with an existing ROS designation for an area would occur that would result in a significant deterioration of the recreational experience designated as appropriate for that ROS; or
- The sights, sounds, or odors emanating from the project would be sufficient, individually or combined, to detract substantially from the Forest visitor's recreation experience.

EFFECTS OF ALTERNATIVE A

Well pads and access roads have been sited either in or adjacent to areas that were previously disturbed by logging or other activities. Variations in well pad visibility from nearby roads are illustrated in table 4.10-1.

Table 4.10-1: Well Pad Tree Screening And Visibility From Nearby Road

Well pad	Tree Screening and Visibility
85-33	No screening; highly visible
64-27	Good screening; not visible
68-8	Moderate screening; partially visible
31-17	Good screening; not visible
87-13	Moderate screening; partially visible

SOURCE: Wardlow 2002

Although exploration activities at the well pads may be observed by dispersed recreational users in the area, proposed activities would not significantly affect the recreational experience of these users (see Section 4.8, Visual Resources).

Operations at each well pad would continue for the following durations:

- Site 64-27: 75 to 105 days (total, though not sequential) for TGH and deep well drilling.

- Site 85-33: 45 to 60 days for deep well drilling, followed by up to 30 days of flowtesting.
- Sites 87-13: 31-17 and 68-8: Each well would undergo 30 days of flowtesting.

Due to the short duration of the activities, and the limited visibility of the proposed well sites, the proposed action would not have a significant impact on recreation in the area.

Effect on Recreation at Medicine Lake

Activities at the well pads would not conflict with developed recreation uses located at Medicine Lake (see Section 4.6, Air Quality, Section 4.7, Noise, and Section 4.8, Visual Resources). Site 87-13 is the proposed project location closest to Medicine Lake. None of the proposed well pads are located within the Recreation Management Area (see Section 3.10, Recreation). The proposed action would not affect lake levels or water quality at Medicine Lake (see Section 4.3, Hydrology), and would therefore not affect water-related or other recreational uses at the lake.

Effect on Recreation at Lava Beds National Monument

Activities at the well pads would not conflict with developed recreation uses located at Lava Beds National Monument since all commercial and industrial traffic to and from the Fourmile Hill Project area would be prohibited from using travel routes through the Monument.

Effect on Dispersed Recreation

Dispersed recreational uses could be temporarily affected by implementation of the proposed action. Drilling and testing activities at the well pads could temporarily alter the use patterns of animal species in the vicinity, possibly limiting hunting opportunities. Camping, hiking, scenic driving and other recreational activities in dispersed recreation use areas could be affected due to the implementation of proposed geothermal exploration activities in these areas. However, given the limited area that would be affected by geothermal exploration and the many areas available for dispersed recreation use in the Modoc and Klamath National Forests, the proposed action would not significantly affect dispersed recreation use.

Road 43N48 (located along the northern shore of Medicine Lake) provides the main access route to the campground areas at the lake. This road would not be used by heavy trucks or equipment associated with the proposed action.

Construction, operation, and decommissioning of the proposed project is not likely to affect snowmobile use patterns since the proposed activities are projected to be completed by the winter season. In the event of unexpected early snowfall or project delay, it may be necessary to plow certain roads to move equipment.

MITIGATION MEASURES

Mitigation Measure 4.10.1: To minimize impacts to winter recreation users, snow plowing would be limited to the following routes:

- 18-28 (previously permitted location): 15 road to 44N01, to 44N64 to 44N54 to well site
- 85-33: 15 road to 44N01, to 44N64 to 44N54 west to 77 and east to well site
- 64-27: 15 road to 44N01, to 44N64 to 44N54 east to 49 to well site

To minimize impacts to winter recreational users on Forest Route 49, an alternative snowmobile route would be maintained for the 0.2 miles of Route 49 which would be plowed and used by project-related vehicles. Ramps shall be constructed and warning signs erected at both ends of the plowed section of Forest Route 49. Additionally, since 64-27 is the only well site that requires access via Forest Route 49, no new drilling operations will commence at site 64-27 after October 15th and before April 30th.

EFFECTS OF ALTERNATIVE B

There would be no adverse effects on recreation use from Alternative B, the "No Action" alternative.

4.11 Transportation and Traffic

SIGNIFICANCE CRITERIA

In accordance with the CEQA Guidelines, a project would be considered to have a significant effect on the environment if it would cause an increase in traffic that is substantial in relation to the existing volumes and capacity of the road network. A project may also have a significant effect on the environment if project traffic or access would conflict with established land uses in the area, such as recreational uses, or would pose public health and safety hazards.

In addition, the USFS considers destruction of existing roadways in the Modoc and Klamath National Forests by heavy truck use to be a significant adverse effect (Sharp in BLM et. al. 1995).

METHODOLOGY

The transportation analysis in this section is based on current operating conditions of project area roadways, as well as anticipated traffic volumes generated by the proposed project. Anticipated project traffic volumes are based on estimates of maximum daily vehicle trips that would occur during construction, operation, and decommissioning of the proposed project. This information was developed by CPN based on construction phasing and project operation information provided in Chapter 2, and was evaluated for this analysis.

IMPACT OVERVIEW

The proposed project would not substantially increase traffic on regional roadways or cause roadway capacities to be exceeded.

Heavy construction equipment access would occur from the northwest for sites 85-33 and 64-27 via Forest Routes 15 and 77 (44N50). CPN would be subject to the same traffic restrictions as those defined in the 1995 Fourmile Hill EA/IS (BLM 1995); the restrictions are described below:

- To minimize impacts to the Lava Beds National Monument and recreational users in the area, all commercial and industrial traffic to and from the project area shall be prohibited from using travel routes through the Lava Beds National Monument.
- To minimize traffic and safety conflicts from traffic generated by the Proposed Action with recreational users in the vicinity of Medicine Lake, construction equipment and truck traffic (>1 ton) to and from the area of the Proposed Action shall be prohibited from utilizing the asphalt-paved portion of Forest Route 49 (44N75) from its northern intersection with Forest Route 77 (44N50) to its southern intersection with Forest Route 97 (44N17). Traffic originating from Highway 139 east of the Medicine Lake Highlands shall follow a path of travel west on asphalt-paved Forest Route 97 to its intersection with gravel-paved Forest Route 44N01, then northwest past Cougar Butte to a gravel-paved section of Forest Route 49 (44N75).
- To prevent undue deterioration of forest roadways and conflicts with winter recreational uses, snow plowing of forest roads and winter access routes to well sites shall be limited as outlined in Mitigation Measure 4.10.1.

Special use permits would be obtained from the Goosenest and Doublehead USFS district offices prior to the commencement of operations.

Existing roads are available to access all sites. The 64-27 site is just east of Forest Route 49. An old skid road provides access to the site. The skid road would require some widening and clearing to allow the large trucks access to the location. The existing road is approximately 8-feet wide due to previous use by logging equipment. The road would require some improvement since it has not had recent use.

All improvements would be limited to minimum width requirements for single lane traffic and would meet USFS standard construction requirements. No import of road construction materials is expected to be necessary, because the native road materials (soils) in the area appear adequate.

Construction employee and vehicle access would be primarily from the northwest via Forest Route 15 or 77 to Forest Route 49 (see Table 2.2-2).

EFFECTS OF ALTERNATIVE A

Projected Traffic Volume

The proposed action would result in increases in traffic as described for each well pad in Table 4.11-1. Equipment would be moved directly from the demobilization of site 88A-28 (previously permitted well) to the set up of site 85-33; therefore, traffic associated with demobilization of operations at 88A-28 is the same traffic as that for set up of operations at 85-33. The data in Table 4.11-1 should be interpreted accordingly. This traffic from demobilization/set up would be over a significantly shorter distance because it is moving from one well site to another. This traffic would primarily use Forest Route 49; only a short segment of Forest Route 77 (44N50) would be used at this stage in traveling from Forest Route 49 to the 85-33 well site.

Table 4.11-1: Projected Traffic For Proposed Well Sites

Well No.	Traffic Description	No. of Total Roundtrips by Activity	No. of Daily Roundtrips by Well Site
64-27	Road and TGH site preparation (1-2 weeks)	73 - 143	6 - 17
	• 3 roundtrips, trucks or tractor/trailers, total	(10 - 11 daily)	
	• ~5 roundtrips, three-axle water truck (TGH) approximately 50,000 lbs. GVW to Arnica Sink, daily		
	• ~5 roundtrips, cars and pickup trucks, daily		
	TGH Set Up (3-4 days):	22 – 47	
	• 7 roundtrips, big rig/flatbeds, total	(6-12 daily)	
	• 5-10 roundtrips, cars and pickup trucks, daily		
	TGH Drilling (30-45 days)	245 – 595	
	• ~3 roundtrips, water truck to Arnica Sink, daily	(8-13 daily)	
	• 5 roundtrips, semi trucks, tractor/trailers, crane, total/dispersed		
	• 5-10 roundtrips, cars and pickup trucks, daily		
	During drill rig set up (7-10 days):	121 - 157	
	• 50-60 roundtrips, semi trucks, tractor/trailers, crane, total/dispersed	(16-17 daily)	
	• ~15 roundtrips, worker vehicles, daily		
	• 7 roundtrips, big rig/flatbeds, total		
	During drilling operations (60 days):	480 - 540	
	• ~20 roundtrips, semi trucks for casing, chemicals and other drilling equipment , total/dispersed	(8-9 daily)	
	• ~8 roundtrips, employee vehicles, daily		
	During demobilization (7-10 days):	121 - 157	
	• 50-60 roundtrips, semi trucks, tractor/trailers, crane, total/dispersed	(16-17 daily)	
	• ~15 roundtrips, worker vehicles, daily		
	• 7 roundtrips, big rig/flatbeds, total		

Well No.	Traffic Description	No. of Total Roundtrips by Activity	No. of Daily Roundtrips by Well Site
85-33	During deep well site prep	261 – 478	4 - 12
	• clay liner, 45 to 50 truck loads, total/dispersed	(12-17 daily)	
	• construction equipment, 6 to 8 loads, total		
	• 5-10 roundtrips, cars and pickup trucks, daily		
	• approximately one water truck round trip to Arnica Sink every hour while placing fill and liner material (average is shown in next bullet)		
	• ~5 roundtrips, three-axle water truck approximately 50,000 lbs. GVW to Arnica Sink, daily		
	During drill rig set up (7-10 days):	85 – 110	
	• 50-60 roundtrips, semi trucks, tractor/trailers, crane, total/dispersed	(12-15 daily)	
	• ~15 roundtrips, worker vehicles, daily		
	During drilling operations (60 days):	480 - 540	
	• ~20 roundtrips, semi trucks for casing, chemicals and other drilling equipment, total/dispersed	(8-9 daily)	
	• ~8 roundtrips, worker vehicles, daily		
	During project testing (30 days):	150	
	• ~5 regular passenger vehicles, daily	(~5 daily)	
	During demobilization (7-10 days):	121 - 157	
	• 50-60 roundtrips, semi trucks, tractor/trailers, crane, total/dispersed	(16-17 daily)	
	• ~15 roundtrips, worker vehicles, daily		
	• 7 roundtrips of big rig/flatbed truck		
31-17	During site preparation – delivering equipment (1-2 days) and set up (1-2 days):	12 – 20	5-8
	• 4 roundtrips, hydro crane and flatbed trucks carrying equipment (1-2 days)	(daily 6-8)	
	• 4 roundtrips, worker vehicles, daily		
	During project testing (30 days):	150	
	• ~5 roundtrips, worker vehicles, daily	(daily ~5)	
68-8	During site preparation – delivering equipment (1-2 days) and set up (1-2 days):	12 – 20	5-8
	• 4 roundtrips, hydro crane and flatbed trucks carrying equipment (1-2 days)	(daily 6-8)	
	• 4 roundtrips, worker vehicles, daily		

	During project testing (30 days): • ~5 roundtrips, worker vehicles, daily	150 (daily ~5)	
87-13	During site preparation – delivering equipment (1-2 days) and set up (1-2 days): • 4 roundtrips, hydro crane and flatbed trucks carrying equipment (1-2 days) • 4 roundtrips, worker vehicles, daily	12 – 20 (daily 6-8)	5-8
	During project testing (30 days): • ~5 roundtrips, worker vehicles, daily	150 (daily ~5)	

SOURCE: CPN 2000, 2000a, 2000b, 2000c, 2000d, Wardlow 2002.

Activities at well site 64-27 would generate the most traffic because the well pad must be constructed and because CPN proposes to drill both a TGH and a deep exploration well at the site. Maximum traffic would be generated during the estimated 30-day combined periods of site preparation, drill rig set up, and demobilization. The maximum potential daily project traffic is due to deep well site preparation activities at 64-27. This would involve a maximum of 17 round trips per day, for an estimated 3-4 weeks. Special use permits issued by the USFS before commencement of project activities would address some of the issues of traffic and structural integrity. Any road repairs due to project-related damages would be paid for by CPN as directed by the USFS.

Effects on Road Traffic

Forest Routes 15 and 77 are designed to adequately accommodate the estimated increase in traffic volumes. The additional trips generated by construction of the proposed action would not be expected to adversely affect traffic volumes or traffic conditions along these roads. As shown in Table 3.11-2, Forest Route 15 has peak traffic of 170 vehicles per day. Forest Route 77 (44N50) east of the junction with Forest Route 15, has peak traffic of 20 vehicles per day. Due to the short duration of activities, traffic associated with the proposed action would not be significant.

Effects on Structural Integrity of Project Area Roads

Forest Routes 15 and 77 are designed to adequately accommodate the estimated increased traffic volumes during project construction, operation and decommissioning. The roads were designed to accommodate heavy vehicle traffic for logging operations; therefore the proposed project would not have a significant effect on the structural integrity of these roads. Forest Roads 44N01 and 44N64 have current traffic volumes of 10 to 20 trips per day (see Section 3.11, Transportation). Previous exploration activities have not caused significant road damage. The increased traffic would not have a significant impact on these roads, based on USFS requirements to repair roads.

The USFS would develop a road maintenance plan for project area roads to ensure that the structural integrity of these roads is not impaired by the proposed project. CPN would be responsible for implementing or financing this maintenance plan and making any necessary repairs. USFS special use permits include provisions for the USFS to collect funds for surface replacement for road damage. The permits include requirements to

maintain the road, i.e. blading, maintaining drainage, and controlling dust. Surface replacement collections are collected to replace the wear on road surface material that is received from the permitted use (i.e. replace worn gravel and pavement).

Mitigation Measures

CPN has proposed a number of measures as part of the plan of operations which would result in less than significant impacts related to traffic and transportation. These are described above. No additional measures are needed to reduce effects to less than significant levels.

EFFECTS OF ALTERNATIVE B

There would be no adverse effects on traffic from Alternative B, the "No Action" alternative.

4.12 Human Health and Safety

SIGNIFICANCE CRITERIA

Human health and safety related impacts that could be considered significant include those that would:

- Create a potential public health hazard
- Involve the use, production, or disposal of materials which pose a hazard to people
- Interfere with emergency response or evaluation plans
- Result in the creation of any health hazard or potential health hazard

In accordance with CEQA Guidelines, exploration activities may be considered significant if the proposed project would:

- **Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials.** The proposed project shall have a significant impact if it significantly increases the current routine transport, use, or disposal of hazardous materials.
- **Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials.** The proposed project shall have a significant impact if it significantly increases the possibility of upset and accident conditions involving the release of hazardous materials.
- **Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within 0.25 miles of an existing or proposed school.** The proposed project shall have a significant impact if hazardous emissions, materials, substances, or waste emissions or handling increases within 0.25 miles of an existing or proposed school.
- **Be located on a site that is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, create a significant hazard to the public or the environment.** The proposed project shall have a significant impact if it is both located on the hazardous materials sites list compiled pursuant to Government Code Section 65962.5 and increases hazards to the public or the environment.
- **Result in a safety hazard for people residing or working in the project area, if the project is located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport.** The proposed project shall have a significant impact if it increases safety hazards for people residing or working in the project area, if the project is located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport.
- **Result in a safety hazard for people residing or working in the project area, if the project is within the vicinity of a private airstrip.** The proposed project shall have a significant impact if it increases safety hazards for people residing or working in the project area, if the project is within the vicinity of a private airstrip.

- **Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan.** The proposed project shall have a significant impact if it impairs implementation of or physically interferes with an adopted emergency response plan or emergency evacuation plan.
- **Expose people or structures to a significant risk of loss, injury, or death involving wildland fires.** The proposed project shall have a significant impact if it increases the exposure of people or structures to a significant risk of loss, injury, or death involving wildland fires.

SENSITIVE RECEPTORS

Receptors of human health and safety impacts that may result from the project include:

- Dwellings and campgrounds around the Medicine Lake area
- Dispersed recreationalists who may visit nearby areas
- Motorists along nearby roads and proposed access routes (see 3.11 Transportation for nearby roads and proposed access routes)
- Schools within 0.25 miles of the project action

IMPACT OVERVIEW

Project impacts on health and safety related to spills of hazardous materials and exposure of receptors to hazardous substances would be less than significant with the implementation of measures proposed by CPN and the proposed mitigation measures. A discussion of potential impacts and their respective mitigation measures is provided in the paragraphs below.

EFFECTS OF ALTERNATIVE A (PROPOSED PROJECT)

Public Safety

The exploration and drilling locations for the proposed project are in areas of low public use and away from major traffic roads. Schools would not be affected by the project since the proposed and existing well sites are all more than 25 miles away from a proposed or existing campus. General public access to the drill sites would be controlled and limited to pre-arranged guided visits. During drilling and testing, the sites would be occupied on a 24-hour per day basis by drilling personnel. The public would be restricted form the site. Caution signs and notices would be posted at access routes and wellpads. All vehicles would be operated in compliance with State of California laws and USFS guidelines.

Hazardous Materials Overview

Hazardous materials that would be used by the proposed project would be the same as those discussed in the 1995 Fourmile Hill Exploration EA/IS (BLM et al 1995a). Geothermal exploration may produce geothermal fluids which, if evaporated may leave residues that may be considered to be hazardous. Materials used in exploration activities that would require special handling include:

- Lubricants,
- Diesel fuels,
- Oils,

- Caustic soda,
- Defoamers,
- Lime,
- Scale inhibitors,
- Sodium bicarbonate,
- Ammonium alcohol sulfate,
- Corrosion inhibitors,
- Polymers,
- Antifreeze

Other drilling chemicals would include natural materials such as:

- Cottonseed hulls,
- Bentonite (clay),
- Ground nutshells,
- Cellulose,
- Salt,
- Lignite dispersant (USDA 1994)

Waste streams from drilling operations would include (as they are in the 1995 Fourmile Hill EA/IS):

- Drill cuttings containing used drilling mud,
- Used engine, gear, and hydraulic oil,
- Municipal-type dry refuse, and
- Empty drums.

All hazardous wastes would be trucked offsite to a certified hazardous waste disposal area (e.g. Chemical Waste Management's facility in Arlington, Oregon or other regional landfills capable of accepting hazardous waste). Drill cuttings that are not hazardous wastes would be disposed of onsite in the sump.

Hydrogen Sulfide (H_2S). Hydrogen sulfide is the principal air pollutant of concern as a potential threat to human health and safety in the proposed project. Detection of the characteristic "rotten egg" odor would provide a "warning" to workers at concentrations well below those considered dangerous.

If H_2S abatement were needed during flow testing abatement chemicals would be used to convert H_2S into sodium sulfate and water, both nonhazardous materials. Chemical abatement is described in detail below. Given the likely low concentrations of H_2S in addition to the implementation of the abatement system, it is unlikely that there would be a significant impact on human heath and safety. Impacts from H_2S are discussed in further detail in section 4.6 Climate and Air Quality.

To further ensure that there would be no H_2S effects from well drilling and testing, the mudlogger would monitor the fluids produced, which may contain H_2S. Drilling rig

alarms would be placed on the floor and would be triggered at 10 ppm and appropriate safety precautions taken.

There is the potential that H_2S odors would occasionally be detectable in the vicinity of the well pads during testing. Based on past drilling experience in the KGRA, these odors would not pose a significant nuisance problem. The low emission rates of the H_2S would result in low concentrations and odors that would be quickly dispersed and diluted to barely detectable or undetectable levels. Given the presence of topographic barriers and distance of the wells to the nearest campgrounds at Medicine Lake, well drilling and testing would not generate H_2S odors that would adversely affect these areas.

Abatement Chemicals. The levels of H_2S in previously drilled wells have been low compared to other geothermal fields. Chemical abatement is not expected to be required. The use of the chemicals is described here in case abatement is desired or required.

Sodium hydroxide and hydrogen peroxide are sometimes used in quantity during well testing to reduce H_2S emissions. The National Fire Association classifies these chemicals as extremely hazardous to health, but areas where they are being used may be entered with extreme care and personal protective equipment may be required.

Abatement chemicals are transported and stored in chemical totes. One caustic container and one peroxide container would be stored on site at all times. The totes are 340 gallons each and would be stored above secondary containment. The secondary containment would include a liner of plastic surrounded by bermed material. The chemicals would be injected into the pipeline after separation where H_2S abatement takes place.

Potential sources of spills/leaks include traffic accidents involving trucks carrying abatement chemicals or leaks in diesel storage tanks, pumps, fittings, lines, etc. Consequences of spills include:

- Health hazards if direct contact with chemicals is made
- Harmful effects on plant and animal life in the affected area
- Contamination of stream water and soils
- Corrosion of metals from substances like sodium hydroxide

Calpine shall implement its Emergency Contingency Plan and Hazardous Materials Plan to ensure no significant effects as a result of use and transport of these materials.

Drilling Muds. Muds are a mixture of water and natural clays, used in drilling operations to lubricate and cool the bit in the hole and to carry cuttings out of the hole. Drilling muds are stored in tanks at the drilling locations. These tanks are open and are adequately sized to hold the volume necessary for the operations. Discharge could conceivably occur by:

- Tank overflow
- Tank breakdown
- Mud discharge from elsewhere on location
- Shallow lost circulation channeling to the surface
- Leakage from trucks and transporting mud

Consequences of drilling mud spills include:

- Possible out-gassing of H_2S from fluid
- Contamination of water causing it to be temporarily unsuitable for human or wildlife consumption.
- Possible detrimental effect to flora and fauna of area affected.
- Increased turbidity of water by particulates carried in fluids or from soil erosion.

Lubricating or Fuel Oils and Petroleum Products. The potential discharge of oils or petroleum products would probably involve a very small volume and be from equipment used at the well sites. Possible locations for accidental spills are drilling equipment, field tanks, and machinery at and around drilling locations.

Hazards related to spills of lubricating or fuel oils and petroleum products include:

- Possible fire hazard
- Stream water and soil contamination
- Harmful to vegetation/wildfire

The existing likelihood of substantial chemical spills and discharges in this area would be low due to the limited amount of chemicals that would be used or transported.

Fire

An increase in potential fire hazards exists during activities of the proposed action. The presence of people in the forested area increases the risk of human-caused fire. Additionally, the possibility exists of causing a fire related to Project activities such as well drilling, use of power tools, and everyday plant operations.

Potential sources of fire from the proposed project include sparks from welding or related operations (cutting, grinding, etc.), exhausts of machinery with defective spark arrests, and steel tracks of equipment striking rocks. Broken glass, if not properly disposed of, may be a fire source as well. Cigarettes, if carelessly discarded, may also be a potential source of fire. Hydrogen peroxide spills (if it is used) are also potential fire sources. Potentially flammable/combustible chemicals that would be used in the proposed project include oil, and fuel. Common natural sources of fire include lightning strikes.

The Plan of Operation/Exploration for the proposed project includes Emergency Fire Control Procedures in addition to fire prevention measures for implementation during construction and drilling (see Appendix E). Combustible materials would be cleared away and disposed of in metal trash containers. All materials would be disposed of at an approved dump site off the lease area.

U.S. Forest Service fire prevention regulations would be posted, reviewed, and distributed to all personnel and service companies at all drill sites. All local, state, and federal fire protection standards applicable to the activities by CPN would be observed. Smoking and parking would only be permitted in designated areas of the well pad. Fire fighting equipment would be supplied to the project site as required by the U.S. Forest Service. Water, fire extinguishers, and hand-held fire fighting equipment would be available on-site during operations. Firebreaks shall be established around wellpads. Fire preventative

measures would be taken during potentially hazardous operations, such as welding. Exhaust stacks from all engines in service would be equipped with spark arrestor or they would be turbo charged. Roads would be graded to prevent vegetation growth; any access roads with vegetation overgrown would not be used until vegetation is removed. All brush and vegetation from newly constructed roads would be disposed of so as not to add fuel for fire.

Emergency Contingency Plans (see Appendix E) have been developed for implementation: An Emergency and Medical Response, Control Procedures for Accidental Spills, a Blowout Contingency Plan, an Emergency Fire Control Procedure, and an H_2S Awareness and Safety.

Well Blowout

The risk of a blowout during proposed drilling operations at the well pads would be considered low. A blowout is an uncontrolled escape of steam, gases, or hot water under high pressure from a subsurface formation that comes into the well and displaces the drilling fluid. A blowout may endanger lives and damage the rig and area adjacent to the rig. The conditions that increase the potential for blowouts to occur include:

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

A Blowout Contingency Plan has been prepared as part of the appended Plan of Operations/Explorations. Appendix E details the Well Blowout Contingency Plan. The drilling fluid program and the blowout prevention system are both designed to indicate and prevent a "kick" or blowout from occurring and controlling the "kick" if one does occur. A "kick" is when large quantities of formation fluids come into the well bore and begin rising to the surface. There are a number of warning signs and detection systems that warn the drilling crew when a "kick" is imminent:

- A drilling rate change occurs that is unexplained.
- Circulating fluid pressure decreases.
- Mudflow indicators show an unexplained drilling fluid volume increase.
- After mud pumps are shut down, drilling fluid still flows from the well bore.
- The mud pit fluid level begins to rapidly rise
- The drilling mud is thinned or diluted.

These indicators all show that fluid is flowing into the well. Under these conditions, if left uncontrolled, a blowout may occur. The first line of defense and the best prevention against a blowout is a properly designed and operated drilling fluid program. A correct drilling fluid program provides for the well bore to contain drilling fluid that is of the proper weight and density so that sufficient hydrostatic pressure is exerted against the downhole formations. The program minimizes the problem of formation fluids entering the well bore.

It is highly unlikely that a blowout would occur with proper installation, testing and maintenance of the BOP equipment and a properly designed and followed drilling fluid program. Over 70 wells have been drilled on federal geothermal leases with only one well becoming a blowout. The well that did blow out and required extensive control work was not due to equipment failure, but was the result of an unqualified individual operator and inadequate safeguards. Additionally, the Glass Mountain Resource is not steam dominated.

Waste Materials

Drill cuttings in the waste sump would be hauled as necessary to appropriate disposal sites, based on content of the materials. This operation would be conducted in accord with federal and state standards.

Drilling Fluids. All drilling fluids would be of a non-hazardous nature. Drilling mud and related fluids would be contained in open steel tanks during the drilling phase. Geothermal fluids would be produced from the deep exploration wells and would be confined to sumps. The sumps would be lined with a minimum of 1-foot of clay material that meets $1x10^{-6}$ cm/sec or less to prevent percolation in accordance with GRO #4 and the Regional Water Quality Control Board's Waste Discharge Orders. Upon completion of the well, a chemical analysis of the fluid contents of the sump and a list of the types and volumes of would be performed. The content of the sumps would then be allowed to desiccate and be covered over or removed to an appropriate disposal site, depending on the constituents of the fluid and in accordance with stipulations of the U.S. Forest Service and the RWQCB.

Waste Disposal. Waste disposal would be conducted in accordance with federal and state standards. Personnel on site would use portable chemical sanitary facilities. They would be maintained and disposed of by a local contractor. All debris, including containers, wrappers, bagging, packing, packaging and related items would be collected and confined to designated waste retention locations. This material would be transported to an approved and designated waste disposal site. Items appropriate for recycling would be collected separately and transported to appropriate recycling depots.

Spills. The drilling supervisor on duty would be notified immediately of any spills or leaks of hazardous materials. The drilling supervisor would supervise complete cleanup and mitigation of any spills according to standard environmental protection regulations. In the event of larger spills with the potential to affect areas off the drill pad, or with the potential to affect drilling operations, the drilling supervisor would contact the project manager and arrange for rapid support materials and personnel needed to contain and clean up. If fluids of high temperatures were released outside of the well pad area, there could be damage to plant life, however unlikely, due to the immediate cooling of the thermal liquids. In addition, due to the porous nature of the soil, fluids would quickly percolate into the soil minimizing the effect.

Materials monitored for accidental spillage and leakage include:

- Petroleum Products
- Drilling Fluids
- Abatement Chemicals

- Geothermal Brines
- Water Pipeline contents

Appendix E details the Control Procedures for Accidental Spills associated with the proposed project.

Emergency Response Plans. The following Emergency Contingency Plans have been prepared as part of the proposed project; they are attached to the Plan of Operation (Appendix E):

- Blowout contingency
- Accident, injury and illness
- Emergency responders and contact information
- Spill response
- Fire plans

MITIGATION MEASURES

CPN has proposed a number of measures as part of the plan of operations to reduce the risk of hazards. Implementation of these measures as described above would result in less than significant impacts related to human health and safety. No additional measures are needed to reduce effects to less than significant levels.

EFFECTS OF ALTERNATIVE B (NO ACTION)

No adverse effects on health and safety would result from Alternative C, the "No Action" alternative.

4.13 Socioeconomics and Public Services

SIGNIFICANCE CRITERIA

The following significance criteria for socioeconomic effects are based on the CEQA Guidelines. Impacts on population and housing would be considered significant if the proposed action would:

- Induce population growth in an area, either directly or indirectly, so that the projected County growth rate of approximately 1 percent is exceeded
- Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere (a "substantial number" refers to one housing unit)
- Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere (a "substantial number" refers to one person)

Impacts on public services would be considered significant if the proposed action would result in:

- The need and provision of new or physically altered private or governmental facilities, the construction of which could cause significant environmental impacts
- Failure to maintain acceptable service ratios, response times or other performance objectives for any of fire protection, police, school, and park services
- Increased demand for public services in excess of their existing and/or projected capabilities
- Failure to maintain acceptable service ratios, response times, or other performance objectives for all emergency response providers

Impacts on utilities and service systems would be considered significant if the proposed action would:

- Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board (RWQCB)
- Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects
- Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects
- Have insufficient water supplies available from existing entitlements and resources, or need new or expanded entitlements
- Result in a determination by all wastewater treatment providers serving the project that they do not have adequate capacity to accommodate the project's projected demand in addition to the provider's existing commitments
- Be served by a landfill with insufficient capacity to accommodate the project's solid waste disposal needs
- Violate federal, state, and local statutes and regulations related to solid waste

EFFECTS OF THE PROPOSED PROJECT

Population

Approximately 10-14 Calpine employees and contractors may be on at a well site at any time. Calpine would have a drilling superintendent, engineer, geologist, and other professional staff on location at all times to supervise the ongoing operation. The personnel requirement of the proposed project would not be a significant impact on the populations of Siskiyou County.

Employment

During drill site and access road construction or improvement local contractors would be utilized. It is estimated that up to 4 to 6 local construction contractor employees would be employed over all, or part, of the six-month period(s) when field activities are in progress. Drilling and flow-testing operations would utilize Calpine employees and various contractor employees. Specific jobs would include a supervisor, geologist, drilling foreman along with a drilling contractor's tool pusher, contract mud engineer, technical staff, administrative staff, drilling crews, and equipment maintenance worker(s). These activities could also generate up to 6 to 10 short-term employment opportunities for the local labor force within Siskiyou or Modoc Counties. Because of the relatively small number of workers needed and the short-term nature of the proposed geothermal activities, no "boom-bust" type of impact would be expected on the local labor pool or economy. The proposed action would have a positive effect on local employment.

Housing

The drilling crews and construction contractors would not live on location. Workers would reside in a nearby community motel, trailer park, or rented house or apartment. The drilling superintendent, drilling contractor tool pusher, contract mud engineer, and contract mud logger would each live in a self-contained trailer on the drill pad. The housing requirement of the proposed project would not be a significant impact on the housing of Siskiyou County. No people, residential housing, or business establishments would be displaced by the proposed project.

Schools

The proposed project would not affect school services within Siskiyou County. Most project employees would not bring families to the site because of the short duration of the drilling and testing work. The activities would take place primarily in the summer when school is not in session.

Environmental Justice

On February 11, 1994 President Clinton issued an “Executive Order on Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations.” The order was intended to focus Federal attention on environmental and human health conditions in minority and low-income communities by having Federal agencies consider whether their actions would disproportionately affect minority or low-income populations. The Order is further intended to promote non-discrimination in Federal programs substantially affecting human health and the environment and to provide for public participation and access to related information. Opportunities for public

participation have been and will continue to be provided through the public scoping process, on-going government-to-government consultation with American Indian tribes in the project vicinity, and the public hearing process.

The proposed project would be located within the Klamath and Modoc National Forests, and would not directly affect the environmental or human health conditions of any American Indian, or other minority or low-income residential communities. Project effects on the local American Indians, tribal land use and associated spiritual values within the project vicinity are described in Section 4.4, Cultural Resources. These effects are insignificant after implementation of the mitigation measures outlined in Section 4.4, Cultural Resources. Other groups of concern, including the elderly and persons with disabilities, would not be affected by the proposed action as it would not affect community provisions and services tailored to these groups.

Construction, operation and decommissioning activities for the proposed project would be located entirely on the Klamath and Modoc National Forests, and not within any residential communities. For this reason, the construction phase of the proposed project would not affect the environmental or human health conditions of any minority or low-income residential communities.

Emergency Services

Calpine would have all equipment on site that is specified in the USFS fire plan for the Klamath National Forest (attached to Appendix E: Plan of Operation). A contingency plan (see Appendix E: Plan of Operation) would be implemented and all company personnel and contractors would be required to read and familiarize themselves with the fire safety plan prior to working at the construction sites. If the fire protection procedures and safety controls are adhered to, the project would result in less than significant impacts to the existing fire and police capabilities.

The small number of construction workers who might move into the communities in the project region could cause some increased demand on County fire and police protection services; however, the level of impact would be negligible due to the small number of people expected to come to the area for the project and the intention of Calpine to use local contractors and vendors as much as possible

Injuries related to construction activities may temporarily increase the demand for emergency services in the project area. The type and frequency of injuries requiring emergency services are difficult to predict. In order to respond to potential emergencies, Calpine would have first aid equipment at the construction sites for the project. Depending on the severity of the injury, Calpine would assume responsibility for transport of any injured personnel to hospitals or other treatment facilities. Vehicles would be available for transport of injured personnel, and Calpine would secure a helicopter and or ambulance to transport injured personnel if necessary. The Emergency Contingency plans (see attachments to Appendix E: POO) would detail all emergency response measures for the project. Calpine's planned measures for accident and injury prevention would reduce the need for emergency services. The increased demand for emergency services would not be a significant effect.

Health Services

The proposed project would not affect health care services within Siskiyou County.

Utilities

The proposed project would not affect the utilities listed below.

Sanitary Sewer. Portable toilets will be on site for workers as well as bottled water. A contractor would bring in the toilets, maintain the toilets during their use, and haul them off when work has been completed. No impacts on sanitary sewer services are anticipated from the project.

Water Supply. Bottled water will be on site for workers. Water usage for drilling would be approximately 200 barrels (12,000 gallons) per day depending on the operation. The pipeline that would be used for flow testing 88A-28 would also be used to bring water from CPN's well at Arnica Sink. The pipeline that would be used to flow test a well at 88-28 and 85-33 would also be used to transport water to those locations during drilling operations. Water would be trucked to 64-27 if a TGH is drilled first. A pipeline would be laid from 88-28 to 64-27 along Forest Route 49 for the deep well drilling. It is also possible that one of the hydrologic monitoring wells required under the Fourmile Hill development plan would be drilled at 88-28 to be used for water during drilling operations once the resource is confirmed. This would allow the removal of the pipeline through Arnica Sink to that water well. Tanks would be on site to hold water for drilling operations. The Arnica Sink well has been successfully used in the past for drilling water. No significant effects occurred from previous use. Impacts on water supply from the project would not be significant.

Storm Water Drainage. No impacts on storm water drainage are anticipated from the project.

Solid Waste. All non-drilling solid waste including trash would be placed in waste dumpsters and periodically removed to the local landfill by a local waste company. Non-drilling solid waste generated is not anticipated to significantly affect local landfill capacity.

All materials used in the drilling operation and wastes generated by the operation would be contained on the well site. Drilling and mud cuttings would be separated. The separated washed solids (drill cuttings) would be placed in the cuttings sump and, upon completion of the well, tested to verify they are non-hazardous under California Title 22 standards before being buried on site. If the solids are found to be hazardous, they would be removed and hauled to an off-site disposal facility authorized to accept the material. The sump would be backfilled and graded to contour or as specified by the RWQCB and USFS if the site is not planned for future use. Auxiliary tanks would be used on site to collect any excess rig runoff and cuttings wash water. Excess cement slurry would be directed to a separate metal waste tank where it would be retained for removal to the cuttings sump or hauled to an offsite facility. Solid waste generation in relation to drilling activities would not conflict with solid waste services and regulations.

Communications. Satellite communication would be used for the project. The contingency plan states that if a telephone contact cannot be made during an emergency, radio communication may be provided by the Medicine Lake Guard Station. Use of satellite and radio communication would not constitute a significant impact.

Power. The proposed project would not involve construction of power lines. Generators would be used for power at the well pad sites. No impacts related to power lines are anticipated.

Property Values.

The proposed project would be temporary and would not decrease property values in the project region.

MITIGATION MEASURES

Mitigation Measure 4.13-1

To facilitate emergency response to fires which could result from proposed activities, the location of selected drill and testing sites, access roads, and the timing of proposed geothermal exploration operations would be provided to the Goosenest District of the Klamath National Forest, the Doublehead Ranger District of the Modoc National Forest, and the National Park Service administration at the Lava Beds National Monument immediately prior to field activities to alert them to the areas of potential increased fire risk.

EFFECTS OF THE NO PROJECT ALTERNATIVE

There would be no socioeconomic or public services effects from implementation of the No Action alternative.

4.14 Unavoidable Adverse Impacts

Based upon the analysis conducted for this document, a number of unavoidable adverse effects were identified. Those impacts that cannot be avoided include:

Surface disturbance of 5.7 acres and potential for increased erosion. Well site construction and road widening requires vegetation clearing and surface grading. Loss of vegetative cover will increase potential for erosion.

Exposure of workers to the potential for natural seismic and volcanic hazards during well construction, drilling, and testing. Geothermal systems are generally associated with tectonic-plate boundaries and volcanic activity. Seismic and volcanic hazards are inherent in geothermal projects and are unavoidable at the Project location.

Temporary release of air emissions during well pad preparation, well construction, drilling, and testing. Dust from vehicle movement over soil cleared of vegetation, steam from geothermal testing, and vehicle and generator exhaust from construction, transport, and drilling activities are all unavoidable in the execution of the Project.

Temporary increase in noise during well pad preparation, well construction, drilling, and testing. Activities such as vegetation clearing, surface grading, construction, drilling and testing are physically intensive and unavoidably produce noise.

Views of the proposed action from long-range and short-range viewpoints. Drill rigs are taller than the surrounding trees, are brightly colored to meet Federal Aviation Administration requirements, and as such are visible from long-range viewpoints. Additionally, steam plumes during testing rise higher than the trees and are also visible from long-range viewpoints. Well sites are situated close to existing Forest roads and as such will be visible to varying degrees from short-range viewpoints along these roads, depending on the amount of screening provided by trees at each site. The proposed action will also be visible to dispersed recreational users passing through the forest close to the well sites.

Reduction in the quality of recreation experience in the vicinity of the proposed action during well construction, drilling, and testing. Due to noise, air quality and visual impacts generated during these phases as described above, recreationalists would potentially experience a decrease in the quality of their recreational experience in the vicinity of the proposed action.

Temporary increase in traffic from construction-related and operational activities. The project requires the transport of equipment, supplies and personnel to and from the well sites and thus involves an unavoidable increase in local traffic during project activities.

Each of these effects is discussed in detail in Sections 4.2 through 4.13. None of these effects are considered to be significant. These unavoidable effects would not occur under Alternative B, the "No Action" alternative.

4.15 Cumulative Impacts

INTRODUCTION

Both NEPA and CEQA require that agencies consider the cumulative impacts of a proposed action or project. NEPA regulations define a cumulative effect as the effect on the environment that results from the incremental effect of the action when added to the effects of other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes the other actions and regardless of land ownership on which the other actions occur. An individual action when considered alone may not have a significant effect, but when its effects are considered in sum with the effects of other past, present, and reasonably foreseeable future actions, the effects may be significant (40 CFR 1508.7 and 1508.8, and FSH 1909.15 Section 15.1).

CEQA Guidelines Section 15355 (b) requires that agencies determine whether a project has impacts that are individually limited, but may be cumulatively considerable. Cumulatively considerable means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.

This cumulative impact analysis considers impacts of the proposed action and other projects that have been proposed, or are reasonably foreseeable to take place in the vicinity of the proposed action. The primary activities considered in the following analysis of cumulative impacts are other geothermal projects and other forest activities that may occur at the same time as the proposed action.

The geographic area considered for cumulative impacts is generally considered to be a 5- to 8-mile radius from the proposed project areas, although boundaries of analysis are dependent upon the type of impact to be assessed. The proposed project would occur in the 2002 season (June to October or November) and the same period in 2003.

GEOTHERMAL PROJECTS

The effects of geothermal projects vary with the type of activity (exploration or development, well drilling or power plant operation). The effects of exploration activities are described in this document. In general, effects of geothermal activities include vegetation clearing for well pads (3 acres), pipelines, access roads, and the power plant (6-10 acres). Power plants also require surface disturbance for the construction and operation of a transmission line. Construction activities create noise and dust; mitigation measures are applied to reduce effects. Well drilling creates noise, includes emissions of hydrogen sulfide in small amounts (controlled through application of Siskiyou County APCD rules and conditions), and creates a visible steam plume. Power plants contribute to background noise and emit a steam plume that is intermittently visible (plumes are most visible during cold, moist conditions). The surface disturbance and noise results in effects to biological resources; mitigation measures reduce the effects to less than significant levels for almost all parameters. Development activities may have potentially significant effects on American Indians if the geothermal activities interfere with traditional practices in the nearby area. The effects of geothermal development in the forests are thoroughly described in the Final EIS/EIR for the Fourmile Hill Geothermal Development Project (1998) and the Final EIS/EIR for the Telephone Flat Geothermal Development.

1995 Calpine Fourmile Hill Exploration Proposal

In 1995, Calpine Corporation proposed a geothermal exploration program within the Glass Mountain KGRA. Calpine Corporation proposed drilling two temperature gradient holes (TGH), 18-28 and 88-28, on Federal geothermal leases CA-21926 and CA-21924 in the Goosenest Ranger District, Klamath National Forest, Siskiyou County, California. These leases are located within the unit boundary of the KGRA, and are now committed to the geothermal unit. The project is referred to as the Calpine Fourmile Hill Exploration Program.

As the first phase of the project, Calpine completed drilling TGH 88-28 in the fall of 1994. The TGH well pad measures approximately 75 feet by 100 feet. In 2001, Calpine proposed deepening TGH 88-28. The proposal indicated Calpine would conduct a deep exploration drilling program at the site if the successful completion of TGH 88-28 confirms the presence of a heat source. Calpine deepened TGH 88-28 in 2001.

Calpine intends to drill a deep exploration well at site 88A-28 in 2002. This well was authorized under the 1995 EA/IS for the Fourmile Hill exploration project. The Siskiyou County APCD issued the permit for the well in 1999. The well pad construction will take place as soon as the snow clears, from May through mid-June. The drilling is expected to begin in July.

Upon completion of 88A-28, the drill rig will be moved to either 18-28 (a previously approved exploration site), 85-33 (proposed site), or 88B-28 to drill a second well. Well site 18-28 was cleared of vegetation in October 2001 in preparation for pad construction and drilling in 2002. A TGH will be drilled at this site first, to evaluate heat flow prior to drilling a deep well.

1995 Calpine Fourmile Hill Development Proposal

In 1995, Calpine also proposed to initiate geothermal development on their Fourmile Hill leases. The Plan of Utilization addressed construction and operation of production and injection wells at five proposed pads, pipelines, a 49.9 MW power plant, and a 24-mile transmission line. Calpine committed to conducting exploration activities and confirming the presence and commercial viability of the geothermal resource prior to initiating activities related to power plant and transmission line construction. The EIS/EIR was completed in 1998 and the Record of Decision was issued in 1999. The EIR was certified in 1998. Calpine has not initiated development activities as of May 2002. The EIS/EIR describes the effects of the project.

1995 CEGC Glass Mountain Unit/ Telephone Flat Geothermal Exploration Proposal

CEGC, as the Glass Mountain Unit Operator, proposed a geothermal exploration program with multiple well pads. Calpine purchased CEGC and renamed the company CPN Telephone Flat, Inc. The effects of the project were addressed in a 1995 EA/IS. None of these exploration wells have been drilled as of May 2002. The activities authorized under this project are not expected to overlap with the proposed project.

1995 CEGC Telephone Flat Geothermal Development Proposal

CEGC proposed to construct and operate a 48 MW geothermal power plant, and associated production and injection wells, pipelines, and transmission line. The EIS/EIR was completed in 1999 and the Record of Decision was issued in 1999. The Record of

Decision reflected the selection of the No Action alternative. The EIR was not certified. The No Action decision is being reconsidered by the BLM and USFS. CPN, as the new owner of the project, has requested that the Siskiyou County APCD consider certifying the EIR. None of the development activities have been initiated. The project activities are not expected to occur at the same time as the proposed project.

OTHER PROJECTS

Klamath National Forest

There are two timber sale projects that may take place within 2.5 miles west of Fourmile Hill on the Klamath National Forest. The timber sales were planned by the USFS and were sold. The two sales are the Kelly Pass sale and the Loop sale. Each sale is for 4 million board feet (mmbf) of timber/chips. They are both four-year sales and are market driven. The exact timing of the timber harvest activities is not known. A third timber sale, the Badger Basin sale, is anticipated. A total of 2800 acres of thinning with no regeneration harvesting would result from the three sales (Siemers 2002, pers. comm.). The three sales are collectively known as the Precommercial Thinning and Release project within the Goosenest Ranger District (Klamath SOPA 2002).

When the logging projects are active, there will be 10 to 15 truckloads per day, with a maximum of 1600 loads of timber and 106 days of hauling over 4 years. About 2800 acres would be affected by the timber harvesting. The timber project traffic would use Forest Road 77 to Forest Road 15, and then travel south to Hwy 89. The project would add traffic, noise, and dust to the forest environment. The activities would result in the loss of vegetation and wildlife habitat and visual effects.

There are other ongoing projects within the district, the effects of which may combine with the proposed action if they occur at the same time:

- **Tamarack Thinning.** This project involves timber harvesting, commercial thinning, 6 acres of regeneration harvesting, and road decommissioning. This proposed project is about 10 to 12 miles southwest of Fourmile Hill (Siemers 2002, pers. comm.). The EA for this project is expected to be reviewed in the winter of 2002.
- **Lava Roost Prescribed Burn, involving TES Terrestrial Habitat Restoration and Enhancement.** The implementation date of this project has been deferred. The location of this project would be at T45N, R3E, MDM.
- **Snow Parks Operation and Maintenance.** This project involves facilities maintenance within T43N, R1W, MDM.
- **Special Forest Products, involving production of special forest products and commercial firewood in various parts of the district.**

Modoc National Forest

There are no ground-disturbing activities currently planned for the Medicine Lake Highlands area of the Modoc National Forest for 2002 or 2003.

CUMULATIVE IMPACTS

2002 and 2003 Projects

Geothermal. The geothermal activities that could overlap with the proposed project and cause cumulative impacts in the summer of 2002 would include the drilling and testing of a deep well 88A-28 (and possibly 18-28). CPN proposes to use one TGH rig and one deep well rig this summer for the activities in the Fourmile Hill project area. The rigs will drill the previously authorized and proposed wells sequentially, and therefore are not expected to cause cumulative noise impacts. The noise impacts would occur for a longer period as a result of both projects occurring in the same summer.

The proposed action may coincide with drilling additional wells in 2003. The drilling program has not yet been set for 2003. More than one rig may be used in 2003 if the drilling during the 2002 summer is successful. If two rigs are used, it is expected that one rig would operate in the Fourmile Hill project area and one would operate in the Telephone Flat project area.

It is unlikely this project would coincide with development activities for the Fourmile Hill Development project. Power plant construction would start after the proposed exploration wells are completed during the summer of 2003. The data gathered from the exploration well drilling and testing would guide design of the power plant.

The proposed project includes flow testing in the Telephone Flat project area. CPN has not identified plans to drill any of the previously approved exploration wells in the Telephone Flat area. The EIR for the Telephone Flat development project has not been certified as of May 2002. The Federal Record of Decision for the project is currently under reconsideration by the BLM and USFS. The proposed well testing in the Telephone Flat area would take place in summer 2002. The well testing would not coincide with exploration or development activities in the Telephone Flat area.

Timber Harvesting. Timber harvesting activities that may contribute environmental impacts of the proposed exploration project are associated with the Precommercial Thinning and Release Project. A total of 2800 acres of thinning with no regeneration harvesting would result from the three sales: the Kelley Pass sale, the Loop sale, and the Badger Basin sale. The area to be thinned is located just west of the Fourmile Hill area. The project would add traffic, noise, dust, biological and visual impacts to the environment.

The Tamarack thinning project would also add traffic, noise, dust, and visual impacts to the environment. It is not anticipated to have a cumulative impact with the proposed project due to the distance (10 to 12 miles) from the proposed geothermal project areas.

Other Projects. Lava Roost Prescribed Burn, involving TES Terrestrial Habitat Restoration and Enhancement, would discharge particulate matters into the atmosphere. The date of implementation of this project has not been determined. If it coincides with the proposed project, cumulative impacts of the prescribed burning with the proposed project could occur. The proposed project contribution would be de minimis because air emissions from well pad construction would be localized and dust would be controlled through watering. The prescribed burning would occur at a far distance.

Geology and Soils

The cumulative impacts study area is the Goosenest Ranger District on the Klamath Forest and the Doublehead Ranger District on the Modoc Forest. The identified projects would add to the continuing alteration in the landscape due to construction of well pads and roads. The alteration includes grading and compaction of the soil for construction of the well pads and the widening of the access road. No clearing or road widening will occur in the Modoc Forest.

In the Klamath Forest, the proposed project would add less than 6 acres of surface disturbance to the tens of thousands of acres of disturbance in the Medicine Lake Highlands (BLM et al 1998). The less than 6 acres for the proposed project would represent a de minimis contribution to the disturbance from the 2800 acres of soil disturbance as a result of logging operations. The identified projects would not result in significant cumulative effects to geology or soils because of the small amount of soil affected by the proposed project (less than 6 acres). The productivity of the soil would not be permanently lost. CPN has proposed erosion control measures that would prevent the loss of soil. If the project is not successful, the well pads would be reclaimed. The proposed project would have a de minimis effect on the cumulative effects to geology and soils.

Hydrology

The cumulative impacts study area for hydrology is the Arnica Sink basin. . The identified projects would result in cumulative water withdrawals from this groundwater system. The water required for the proposed projects would be withdrawn from the CPN well in Arnica Sink. The withdrawals would occur over a period of approximately 6 months per year over two years (2002 and 2003). Previous water withdrawals for geothermal drilling have not caused significant effects on groundwater quality or quantity. There are currently no other water withdrawals in the Arnica Sink area that would contribute to cumulative effects. The identified projects are not expected to result in cumulatively significant, adverse impacts to surface or groundwater quality or water availability because of the limited amount of water used and the relatively short duration of the withdrawals.

Cultural Resources

Archaeological and Historic Resources. The area of cumulative effect could be considered to be the Klamath and Modoc forests. The proposed action would not affect any known archaeological or historic resources. Site 64-27 will be surveyed for the presence of cultural resources when the snow clears in May. If resources are found, they will be avoided or the data at the site will be recovered so that no adverse effects to cultural resources would occur. The mitigation is designed to ensure avoidance of cultural resource or sites (if they are identified) or that no adverse effect to cultural resources can occur from implementation of the proposed project.

There have been many archaeological and historic sites identified on the Klamath and Modoc forests. No effects to cultural resources would occur as a result of testing of the three wells on the Modoc Forest.

Site 85-33 contains no known cultural resources and the construction of the pad would not result in cumulative effects to cultural resources in the Klamath Forest.

The construction of 64-27 has a low potential for affecting cultural resources. The effects could be avoided by relocating the site to avoid any identified resources. If resources are identified at site 64-27 and cannot be avoided, mitigation will be implemented and the data the site contains would be recovered. An effect to resources at this site, if it occurs, would not be cumulatively significant because mitigation would be implemented. The proposed project would not contribute to cumulative effects to resources on the Modoc or Klamath Forests. The project would not contribute to a cumulative effect on cultural resources in the region.

Traditional Cultural Values. The study area for cumulative effects to traditional cultural values includes the Medicine Lake Highlands area. American Indian groups have expressed concern about geothermal activities in the Forests. Pit River and Klamath Tribe consultants indicated in the Assessment of Effects conducted for the Fourmile Hill geothermal development project (power plant and transmission line construction and operation) that alterations in the existing environment associated with the development project would be "out of character" and would constitute effects on the cultural integrity of the sites. Representatives of the Shasta Tribe had intended to support, with resolution, the concerns and efforts of the Klamath and Pit River Tribes on the development project..

Noise. The proposed action would have substantially less audible and visual effects than the Fourmile Hill and Telephone Flat multiple well pad, power plant, and transmission line development projects. The audible and visual effects of the project may be noticeable at some Traditional Cultural Properties (TCPs) if tribal use of the sites coincides with drilling nearby. The proposed activities would combine with noise from other forest activities (recreation traffic, motorboats on Medicine Lake, the camping and houses around Medicine Lake, USFS activities, and logging) if they occur simultaneously and in close proximity to the TCPs. The cumulative noise effect would be less than significant because the proposed activities would not necessarily be in close proximity with or combine with recreation noise. The other forest activities (such as timber harvests and thinning) are located several miles from the proposed well sites. Cumulative effects on traffic would not be significant (see cumulative noise and traffic analyses below).Cumulative noise generated from traffic would not significantly affect TCPs.

Drilling in 2002 for the proposed and previously approved geothermal projects would be sequential; the drilling schedule for 2003 has not been determined. CPN has indicated that one drill rig would be used in the Fourmile Hill project area and one rig would be used in the Telephone Flat project area. The project areas are approximately4.5 miles apart. The noise of drilling would not be additive and the effect would not be cumulatively significant.

Views. The proposed grading of the well pad is not expected to be visible in the landscape view from TCPs. The proposed action would result in activities (steam plume and well pad lighting) that would be visible or potentially visible from 14 of the TCPs (see Section 4.4). These impacts would depend on the direction of sight during ceremonial activities. If views are not in the direction of the project facilities, there would be no effect. Effects would be less than significant from many TCPs due to the distance to the proposed activities and the difficulty in seeing the facilities against a forest backdrop. Drill rig masts and lights are often difficult to distinguish against the dark forest canopy. Steam plumes may not be distinguishable from natural condensation formations (i.e., fog, low-lying clouds) within the KGRA. Some observers consider steam plumes a positive effect within

the KGRA as steam plumes contribute to the volcanic character of the area. The visual effects would be expected to be temporary and less than significant.

Visual effects of the project may compound with visual impacts from timber harvesting activities just west of the Fourmile Hill area. TCPs 6, 7, 9, and 10 in Table 4.4-1 may have potential views of timber harvesting, and at the same time have potential views of steam plumes (rig mast lighting would not have a cumulative effect as timber harvesting impacts would not be seen at night). Because steam plumes may not be readily distinguishable from natural condensation formations and are considered by some as a positive effect, the cumulative visual impacts on TCPs are considered less than significant.

Access. The proposed and cumulative projects would not prevent American Indian access to TCPs. The proposed exploration project would be temporary and would not significantly affect the access to or the integrity of any sites due to the small scale of the proposed activities (3-acre areas) and the temporary nature of the drilling and testing.

The TCPs within the KGRA are protected by the stipulations in the Memorandum of Agreement between the USFS, BLM, SHPO, and the Advisory Council on Historic Preservation (see Section 3.4). The MOA includes creating a Historic Properties Management Plan, which would define additional means of avoiding or reducing effects to cultural resources and TCPs. The MOA and mitigation measures (proposed by Calpine and defined in Section 4.4 Cultural Resources) would reduce conflicts with American Indian use of the region. The proposed project would thereby have a negligible contribution to cumulative effects on American Indian use of the TCPs in the Medicine Lake Highlands. The mitigation measures require that CPN notify the tribes prior to project commencement and to provide updated schedules to the tribes if the schedule changes. The BLM will notify the tribes and provide the project Decision Notice when the decision is made whether or not to approve the proposed project.

Other projects in the area are not anticipated to have impacts on access to the TCPs, as these sites are protected under the MOA between the USFS, BLM, SHPO, and the Advisory Council on Historic Preservation. No cumulative impacts to TCP access are anticipated.

Biology

The biological cumulative study area would include the Medicine Lake Highlands. The proposed action would result in the surface disturbance or grading of approximately 6 acres, much of which has been previously disturbed or thinned by logging operations. The Klamath National Forest timber sale would affect over 2800 acres west of the Fourmile Hill area. The proposed project would not represent a significant additive effect to that of the timber sale because of the extremely small amount and low quality of the habitat impacted. The cumulative loss of habitat from the proposed project is not a significant loss of habitat because of the abundance of similar habitat in the Medicine Lake Highlands region. The proposed mitigation measures would further reduce or minimize any potential habitat impacts. The proposed project would have a de minimis effect on the cumulative effects to vegetation and wildlife in the area.

Noise disturbance from the increased human activity and traffic of the timber harvest would not result in a significant cumulative effect to wildlife when considered with the proposed project. The traffic and activity of the timber sale would occur distant to the proposed well site areas and would not be additive to the proposed project. The proposed

project would only intermittently and temporarily add to the noise levels in the forests, and noise levels would be well below the 65 dBA standard identified in the GROs. The proposed project would not cause significant cumulative impacts because of the distance between the projects and the noise attenuation properties of the trees and intervening topography.

The temporal overlap of the drilling of 88A-28 (and possibly 18-28) with the proposed project would reduce cumulative traffic disturbance and noise because CPN staff may work on projects simultaneously. Drilling activities for these projects would also be temporary and seasonally restricted; distance and the attenuation properties of the trees and intervening topography would minimize associated noise. Geothermal exploration activities did not result in significant cumulative effects in the past environmental analyses. The cumulative traffic-noise effect of these exploration projects and the proposed project on wildlife would not be significant.

Air Quality

The air quality study area is generally the air basin. The proposed and cumulative projects would emit PM_{10} from construction and criteria pollutants from cars, trucks, generators, and earthmoving and logging equipment. The emissions of the individual projects were found to be less than significant and are not expected to combine to cause exceedances of state or federal standards due to the mitigation applied, the distances between the projects, and the limited emissions.

Geothermal well drilling would be sequential with one core rig and one deep rig operating, thus proposed drilling emissions would not have a cumulative effect. The key geothermal emission of concern is H_2S. Flow testing (with H_2S emissions) would occur one well at a time and would not exceed the Siskiyou County APCD emission standards or state standards. None of the cumulative projects would emit H_2S at the same time as the proposed project. Air emissions from the proposed geothermal project would be short-term and temporary and would not be expected to represent a cumulatively significant impact on air quality in the region. Emissions controls on equipment and watering of roads and construction sites for dust control would avoid the potential for cumulatively significant air quality effects.

Noise

The identified projects would intermittently add to the noise levels in the Goosenest and Doublehead Ranger Districts. The proposed project noise levels would be well below the 65 dBA standard identified in the GROs. Geothermal project noise would be generated by vehicles, pad construction equipment, drill rigs and generators, and flow testing. The other projects in the forest would generate similar noise from timber activities. The proposed project would not cause significant cumulative impacts because of the distance between the projects and the noise attenuation properties of the trees and intervening topography. Operation of two geothermal projects was not expected to result in significant cumulative noise impacts at Medicine Lake cabins (BLM et al 1998). The proposed project contribution to the noise levels would be de minimis. Cumulative noise generated from traffic would not significantly affect ambient noise along access routes.

Visual Resources

The visual resource study area would be the Highlands and the surrounding vantage points. The surface disturbance for the new 3-acre well site (85-33) would be visible from Forest Road 77. The proposed site was previously logged. The other sites are existing disturbed areas with limited visibility from forest roads. This new site would not result in a significant cumulative effect in the forest because of the small amount of clearing compared to the tens of thousands of acres cleared for logging in the forests.

The areas of disturbance for the proposed action are several miles from long-range view points and would be difficult to distinguish from that distance. The contribution of the proposed action is considered minor because the well sites are existing or have been partially cleared of vegetation during previous logging operations.

The identified projects would add intermittent visual disturbance to long-range views during the time the drill rigs would be visible above the tree line and during the testing period when a steam plume could be visible above the tree line. Steam plumes would be intermittently visible, depending on temperature and humidity. These impacts would not be considered significant cumulative effects because of the limited and short-term nature of the visual intrusion, and the distance between the identified projects. The short-term presence of drill rigs and steam plumes would result in a less than significant contribution to the cumulative effects on visual resources from past, present, and reasonably foreseeable future actions.

Land Use, Recreation, and Transportation

Land Use. The cumulative impacts study area is the KGRA. The identified exploration projects are short-term and temporary and are not expected to result in a cumulatively significant impact on existing land uses such as recreation, timber harvesting, and other land uses in the area. The geothermal development projects would not represent new land use in the area since other geothermal projects have been and continue to be underway. Geothermal development is provided for by the geothermal leases administered by BLM in the area, and it is consistent with existing Klamath and Modoc National Forest Plans and Siskiyou and Modoc County General Plans. With the implementation of project specific mitigation measures, the identified projects are not expected to result in a significant cumulative impact on existing land uses.

Recreation. Geothermal exploration in the area would result in short-term and temporary impacts which may affect dispersed recreation in the area, but these impacts are not expected to be significant. The identified geothermal development and timber projects would not be located in the immediate proximity of developed recreation sites. The projects have the potential to result in impacts that could adversely affect dispersed recreation in the area. With the implementation of project-specific mitigation measures, the identified projects are not expected to result in a significant cumulative impact on recreation.

Transportation Systems. The proposed project would add to the cumulative traffic in the forests. The temporal overlap of the drilling of 88A-28 (and possibly the TGH at 18-28) with the proposed project would reduce cumulative traffic because CPN staff may work on both projects.

The project may or may not coincide with the timber sale activities west of Fourmile Hill, depending on whether timber economics dictate timber harvest in 2002 or later. The timber sale traffic and the project access to well sites 64-27 and 85-33 would both use Forest Roads 77 and 15. The geothermal traffic would use Forest Road 77 and 15 to bring in the TGH and deep well drill rig and heavy equipment to the Fourmile Hill project area. The rig traffic would use Forest Road 77 and 85-33 at the beginning of the drilling season (probably mid-June) and then again in November when the rig leaves the Highlands for the season. Most of the geothermal project traffic (other than bringing in the rigs) in the forests would be passenger cars traveling daily to the well sites and moving the rigs between sites 88-28, 64-27, and 85-33. These sites are all within about 1 mile or less from site 88-28.

Timber harvest and geothermal exploration traffic did not result in a significant cumulative traffic effect in the past. The cumulative traffic effect of the proposed project would not be significant.

Human Health and Safety. The proposed project and the cumulative projects would increase the potential for health and safety effects in the Medicine Lake Highlands. The equipment used in the cumulative projects could contribute to a cumulative risk of fire. The effect would be less than significant because of the mitigation measures that the project proponents would employ to reduce the risk of fire. All projects would adhere to USFS requirements and would be subject to the emergency fire response programs.

Transport of hazardous materials would be minimized and subject to USFS and other regulations pertaining to transport and storage of regulated materials. The public would be restricted from the immediate areas of operations.

The proposed project would have a less than significant effect on human health and safety in the region due to the regulations and procedures in place to minimize effects. The project would not contribute to significant cumulative health and safety effects in the area.

Socioeconomics. The proposed project would have very limited effects on the socioeconomics of the region. The workers that stay in the area would temporarily contribute to the local economy. The cumulative impacts would not be significant. The proposed project, in combination with cumulative projects would not be expected to result in significant adverse cumulative impacts to public services, including police, schools, fire protection, emergency services, water supply, sanitary sewer, sold waste or public utility systems. The proposed project would not bring long-term residents to the area and therefore would not significantly increase demand for services.

CUMULATIVE EFFECTS OF ALTERNATIVES

The No Action alternative would avoid all contributions to cumulative effects in the project area.

CONCLUSION

The proposed project would have a less than significant contribution to cumulative impacts within the Medicine Lake Highlands and the Glass Mountain KGRA.