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MAMMOTH PACIFIC GEOTHERMAL DEVELOPMENT PROJECT: UNITS II AND III

ENVIRONMENTAL IMPACT REPORT
ENVIRONMENTAL ASSESSMENT

PREPARED FOR:

COUNTY OF MONO
ENERGY MANAGEMENT DEPARTMENT AND

BUREAU OF LAND MANAGEMENT

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ESA
PLANNING AND ENVIRONMENTAL SERVICES

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MP II & III GEOTHERMAL
ENVIRONMENTAL IMPACT REPORT

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Hydrologic Study for the MP II and MP III Geothermal Project Joint EA/EIR prepared by Berkeley Group Inc., July 1987 is available in a separate volume from Mono County Energy Management Department.

1.0 SUMMARY

1.1 INTRODUCTION

Mammoth Pacific of Commerce, California, is proposing the construction and operation of the Mammoth Pacific II & III (MP II & III) project consisting of two 12 megawatt (MW) (nominal) binary cycle geothermal electric generating plans in the southwest part of the Long Valley in Mono County, California. The proposed power plants would be located on private land, a 90-acre parcel on which the project applicants hold a lease interest in the geothermal resource. The proposed well fields for MP II would be located on the same private property. The well fields for MP III would be located on U.S. Forest Service land located north of the plant site in lease CA-11667A. The geothermal lease on this 80-acre parcel of federal land is administered by the Bureau of Land Management (BLM).

In order to initiate this project, Mammoth Pacific has applied to the County of Mono for a Conditional Use Permit (CUP) for the construction and operation of the generating plants, the production and injection well fields, pipelines for transmission of the geothermal fluid, and an electrical transmission line. Consideration of this CUP requires a discretionary action by the Mono County Planning Commission, with the Mono County Board of Supervisors having the power to overrule their decision on appeal. The Initial Study by the Mono County Energy Management Department indicated that the proposed project may adversely affect the environment (see Appendix A). Part of the project would utilize federal land. The BLM has determined that a full Environmental Impact Statement (EIS) is not required, but that the major issues raised in the County's Initial Study must be assessed to satisfy federal requirements for environmental review. Accordingly, this Environmental Impact Report/Environmental Assessment (EIR/EA) has been prepared to address the potential impacts of the project in accordance with the requirements of both the California Environmental Quality Act (CEQA) and the National Environmental Protection Act (NEPA).

An EIR/EA is an informational document intended to provide decision-makers (in this case, the County Planning Commission and Board of Supervisors and the BLM), other responsible or interested agencies, and general public about the environmental effects of a proposed project. The process of environmental review under CEQA and NEPA is designed to enable public agencies to evaluate a project, determine its environmental consequences, consider methods of avoiding or reducing adverse impacts, and evaluate alternatives to the project. Both CEQA and NEPA restrict their definition of "significant impact" to be an adverse environmental impact; economic and social considerations are beyond their scope. However, responsible public agencies remain obligated to balance the environmental effects against other public objectives, including social and economic factors, in determining whether approval should be granted to a particular project.

The Mono County Energy Management Department and Planning Commission, respectively, have the principal responsibility for carrying out the environmental review process under CEQA and approving the CUP. The BLM is the federal lead agency under NEPA. In addition, several other public agencies have been identified as having jurisdiction or a review function over a portion or portions of the project. These agencies include the U.S. Forest Service (USFS) and the U.S. Geological Survey (USGS); the State of California Department of Fish and Game (CDFG), Office of Planning and Research, Division of Oil and Gas (CDOG), Regional Water Quality Control Board (RWQCB), Air Resources Board (ARB), Energy Commission, Native American Heritage Commission, and Office of Historic Preservation; the Great Basin Unified Air Pollution Control Board; the Mono County Planning Department, Sheriff's Department, and Department of Public Works; the Long Valley and Mammoth Lakes Fire Protection Districts; and the Town of Mammoth Lakes Planning Department.

1.2 SUMMARY

The EIR/EA addresses the anticipated environmental consequences of constructing and operating two 12 MW (nominal, equivalent to 10 MW net after parasitic power use at the plant) power plants, their associated geothermal fluid production, handling, and injection facilities, and the electrical transmission lines. The following summary describes the project-related impacts by major subject area and the mitigating actions proposed to reduce the extent of adverse impacts. This information is summarized for the convenience of the reviewer and is not intended to supercede the more detailed analyses in succeeding chapters of the document.

Environmental Category	Major Impacts	Mitigation Measures (Keyed to Specific Impacts)	Expected Result of Mitigation
Geology, Geologic Hazards and Soils	The proposed project is in a geologically active area and may be affected by fault rupture.	Site major facilities away from known fault traces. Design facilities to withstand fault offset without failure. Develop an emergency spill containment plan prior to operation.	Effects of fault rupture would be reduced or eliminated.
	The proposed project area may be affected by seismic groundshaking.	Design all project facilities to withstand the predicted levels of groundshaking (horizontal acceleration of 0.4 to 0.6g) without structural failure.	Effects of groundshaking would be reduced or eliminated.
	The proposed project may be exposed to volcanic activity.	Establish emergency shutdown procedures. Inspect and maintain shutdown controls regularly.	Impacts of a large eruption are essentially unmitigable. Emergency shutdown would prevent hazardous conditions during periods when operators cannot reach the power plants.
	Degradation of water quality in Mammoth Creek and Hot Creek is likely to occur due to erosion and sedimentation impacts during construction.	Adhere strictly to the Lahontan Regional Water Quality Control Board (RWQCB) guidelines for the Mammoth Creek watershed. Disturb no more than one-quarter acre of soil before implementing erosion control measures. Construct all roads to U.S. Forest Service (USFS) standards. Build new access roads following hillside contours. Stockpile soil for use in revegetation. Revegetate using native grasses, shrubs, and trees.	Erosion and sedimentation impacts would be substantially reduced.
Water Quality and Hydrology	Accidental spills of geothermal fluid temporarily could raise the temperature of Mammoth Creek and Hot Creek. This could be caused by a well blowout or by a pipeline rupture during operation.	Have detailed blowout contingency plan. Regularly test and maintain automatic pump shutdown system. Adequately maintain containment dikes and catchment basins.	Temperature effects would be minimized.
	Surface water could be contaminated by runoff from soils that are contaminated by leakage or spills of fuels and other chemical compounds used on the site.	Maintain site and vehicles regularly. Store and handle potentially hazardous materials properly, following RWQCB requirements.	Significant contamination of soils or surface runoff would be prevented.

Environmental Category	Major Impacts	Mitigation Measures (Keyed to Specific Impacts)	Expected Result of Mitigation
Water Quality and Hydrology (cont.)		Have a detailed spill contingency plan which should include: 1) immediate removal of spilled fluid by pump trucks for proper disposal; 2) construction of containment dikes with heavy equipment; 3) removal of contaminated soils; 4) immediate cleanup; and 5) notification of appropriate public agencies.	
	Impacts on surface thermal features resulting from production/injection operations at the proposed project are difficult to predict. Experts studying the geothermal reservoir do not agree on how fluids move within the reservoir. One model (Upwelling/Fracture Flow) postulates that deep upwelling from separate sources feeds multiple reservoirs, so that pumping at Casa Diablo would have no effect on the reservoir(s) at Hot Creek. The second model (Lateral Flow) proposes a source of geothermal fluid in the southwestern part of the caldera, with fluid movement toward the east. Calculations done using this model indicate that, using the information currently available about reservoir characteristics, there would probably be no effect on reservoir pressure or temperature beneath Hot Creek; however, there is the possibility that due to the lack of information about reservoir characteristics, the numerical modeling predictions are inaccurate and there could be an effect on the geothermal resource at Hot Creek Hatchery or Hot Creek Gorge.	Establish a program of fluid monitoring (see Table 4-3). Measure chemistry, flow rate, and temperature of important surface features; temperature, pressure, flow rate, and chemistry of observation wells; injection well pressure; and production well temperature, pressure, flow rate, and chemistry.	Fluid monitoring may help distinguish impacts due to natural causes (such as tectonic strain and seasonal precipitation amounts) from impacts attributable to power plant operations.
		If spring flows or temperatures were reduced at Hot Creek Hatchery or Hot Creek Gorge, due to MP II & MP III power plant operations, Mammoth Pacific could: 1) supply hot water by pumping geothermal fluid and delivering it to the hatchery; 2) supply lost flow of hot water to the bathing area; and 3) reduce or stop MP II & III power plant operations.	If geothermal fluid is delivered to Hot Creek Hatchery, impacts at the hatchery would be eliminated but would increase slightly elsewhere. If a well were constructed at Hot Creek Gorge, lost flow would be replaced, but scenic value and visitor appeal as it currently exists would not be restored. If the MP II & III power plant operations were reduced or shut down, flow levels of springs would not be restored immediately, because of the time required for the system to recover.
Noise: Construction	Temporary noise from construction-related activities may affect nearby wildlife and occasional recreational users of adjacent forest areas.	Use muffling devices on construction equipment.	Noise level would be reduced on diesel-powered equipment by up to 10 dBA.
	A temporary increase in traffic noise along State Route 203 and Hot Springs Road could affect wildlife and passers-by.	Establish vanpools or carpools and limit construction activities (except drilling) to 7:00 a.m. to 4:00 p.m.	This would reduce the total number of trips and would also reduce the noise levels at night.
Noise: Drilling	Noise levels of 77 dBA, L_{eq} are estimated for drilling. A total of 16 wells are planned, each requiring at least 12 days (24 hours per day) of drilling time.	Drill no more than one well at a time. Follow OSHA and GRO 4 regulations.	Noise levels would not exceed 65 dBA at the lease boundary or 0.5 mile from the source, whichever is further.

Environmental Category	Major Impacts	Mitigation Measures (Keyed to Specific Impacts)	Expected Result of Mitigation
		Use air-cooled condenser fan to dilute and disperse leaked vapors. Use vacuum trucks to collect the vapor.	Vapors would be dissipated or removed.
		If the cloud of vapor were to ignite, relief values and discharge valves should be opened to reduce the quantity of material available for combustion and the material should be burned off.	
Vegetation	Development of the proposed power plants would remove up to 26 acres of available natural habitat from the area.	Avoid damaging existing vegetation whenever possible. Utilize areas which are already disturbed.	The loss of natural habitat would be lessened.
		Revegetate all disturbed areas with native trees, shrubs, and grasses. Newly planted seedlings should be drip irrigated to promote growth and fenced for protection. Their survival should be monitored.	Without irrigation, seedlings of Jeffrey pine could be expected to reach between five and eight feet in height with a diameter at breast height of 0.6 to 2.2 inches after ten years.
	Botanically sensitive rhyolite buckwheat scrub communities are located near proposed facilities and may be affected by pipeline construction.	Adjust the locations of wells to avoid botanically sensitive areas, all of which are located on private property. Rhyolite buckwheat scrub communities should be fenced for protection.	Damage to sensitive plant communities would be minimized.
Terrestrial Wildlife	Noise and human activity may reduce songbird density near the power plants and may cause migratory deer to avoid the area.	Follow the recommended mitigation measures for noise.	Noise levels would be reduced to 65dBA at the lease boundary or 0.5 miles, whichever is further. This may lessen impacts to songbird and deer populations, but the effect is not certain.
	Deer pass through the area on their twice-yearly migrations between summer and winter ranges. Human activity in the Mammoth Lakes area is putting increasing pressure on their traditional migratory routes.	Construct crossing ramps over pipelines or bury short segments. Design fencing and pipelines to avoid a funneling effect.	Physical barriers to deer migration would be minimal.
		Require the project sponsor to contribute toward purchase of federal lands in Swall Meadow in Round Valley.	Winter range would be protected.
Aquatic Resources	Increased sedimentation in Mammoth and Hot Creeks may result from grading new roads and building surfaces. Elevated turbidity levels would clog and irritate gill structures and interfere with respiration, feeding, and swimming capabilities of resident fish and aquatic invertebrates.	Implement the erosion and sedimentation control measures described in Section 4.1.1.1., including those required by the Lahontan RWQCB for storage of hazardous materials.	Turbidity effects would be reduced.

Environmental Category	Major Impacts	Mitigation Measures (Keyed to Specific Impacts)	Expected Result of Mitigation
Noise: Operation	The combined noise level if MP I, MP II and MP III were operating would be 4 to 5 dBA louder than MP I alone, an increase noticeable to people and wildlife in the vicinity.	Noise-muffling devices should be installed at all three power plants.	Noise levels would be reduced by 10 to 12 dBA, Leq, at each plant.
		Apply GRO 4 standards to all three power plants.	Noise levels would not exceed 65 dBA at the lease boundary or 0.5 mile from the source, whichever is greater.
Air Quality: Construction	Earthmoving and construction activities would generate large amounts of dust and small amounts of CO, NO_2, SO_2, and hydrocarbons. This may create a temporary health hazard or degrade visibility in nearby areas.	Wet down construction sites during development at least twice a day.	The amount of dust would be reduced by up to 50%.
		Cover stockpiled materials and loaded trucks and do not overfill trucks. Minimize the area disturbed and revegetate promptly.	Dust would be further reduced.
		Minimize traffic and speeds at construction sites.	Both dust and engine exhaust would be reduced.
		Clean up off-site spills promptly. Use water-based paints and architectural coatings where feasible.	Evaporation of pollutants would be limited.
Air Quality: Drilling and Testing	A blowout during well drilling or the required cleanout and testing would result in the release of up to 3.6 kg/hr of H_2S for a two- to four-hour period at each well. H_2S levels would exceed the state one-hour standard but would not pose a health hazard.	Limit drilling,cleanout and testing activities to one well at a time.	No more than one well would contribute to the H_2S emissions.
	A slight potential for road icing and induced fog clouds would exist during flow testing.	Conduct flow tests under atmospheric conditions that would minimize induced icing and fog clouds.	The potential for hazardous conditions would be reduced.
Air Quality: Operational Phase	A five-minute spill of geothermal fluid supplying one power plant (5,000 gpm) would result in emission rates of H_2S of approximately 9 kg/hr. This would exceed the Air Pollution Control District (APCD) and state one-hour standards and would cause irritation to eyes and respiratory tract.	Maintain emergency shutdown equipment so that flow would be stopped promptly.	Hazardous levels of H_2S would be produced for a brief period.
	Isobutane working fluid would be released from each plant at a rate similar to the loss at MP I of 4.6 cubic feet per minute or 1000 pounds per day.	Great Basin Unified APCD would require remedial control action with regard to the release of isobutane to the atmosphere.	No more than 250 pounds per day of isobutane would be released.
	A major rupture of the isobutane system could cause release of 200,000 cubic feet of working fluid to the atmosphere.	Add an an appropriate level of odorant (mercaptan) to the isobutane. Install hydrocarbon sensors and alarms to alert personnel.	Plant personnel would be informed of the leak immediately.

Environmental Category	Major Impacts	Mitigation Measures (Keyed to Specific Impacts)	Expected Result of Mitigation
Aquatic Resources (cont.)	Accidental spills or leakages of organic compounds used during drilling and construction could cause adverse effects on aquatic resources.	All compounds potentially harmful to aquatic organisms should be stored in secure containers within the bermed areas so that leaks would be contained. Follow requirements of the RWQCB.	The potential for accidental spills or leakages to affect aquatic resources would be greatly reduced.
	Thermal shock from a large spill of geotheraml fluid could cause some mortality of aquatic organisms in Mammoth Creek.	Reduce the maximum flow of geo-thermal fluid which could reach Mammoth Creek.	The Mammoth/Hot Creek fishery would not be adversely affected.
	There is a possibility that the production of geothermal fluid at the project may eventually decrease the temperature or amount of thermal water reaching Hot Creek Hatchery. This would adversely affect hatchery operations.	Supply the necessary thermal water by drilling wells to tap the geothermal reservoir.	This mitigation measure will supply the necessary thermal water, but would further deplete the geothermal reservoir and would require an investment in equipment to achieve the appropriate mix of pumped and spring water.
		Stop or reduce production at the geothermal plants.	Results would not be felt immediately because of the slow response time within the geothermal reservoir.
	The endangered Owens Tui Chub may be present in waters which could be affected by the project.	A survey of water in the project area should be undertaken to confirm the presence/absence of the Owens Tui Chub. If any are found, they will be protec-ted pursuant to stipulations rendered by a biological opinion to be prepared by the U.S. Fish and Wildlife Service as specified by Section 7 of the Endangered Species Act.	Owens Tui Chub would not be adversely affected.
Visual Resources	The proposed power plants would be visible from scenic highways and would conflict with the Visual Management Objectives of the USFS for federal land surrounding the project.	Lay out well pads and roads so that mature trees are preserved. Revegetate disturbed soil areas promptly. Plant native trees and shrubs to screen equipment yards and accessory structures, and the lower parts of major structures. Use rough textures and neutral earth-tone colors for exterior surfaces. Minimize exterior structural light. Insert redwood laths in chain link fencing. Apply the above mitigation measures to the MP I plant.	The power plants would be less con-spicuous; however, they would still be noticed by casual observers and would be inconsistent with the USFS Visual Management Objectives for the vicinity.

Environmental Category	Major Impacts	Mitigation Measures (Keyed to Specific Impacts)	Expected Result of Mitigation
Visual Resources (cont.)		Locate the plant 400 to 500 feet east of the proposed plant site.	Existing mature trees would partially screen the power plants.
Land Use and Planning	The addition of two power plants and their appurtenant features would increase the industrial nature of the area, increase erosion, and remove some range and timber land.	See Section 4.1.1.1, Soils and Erosion; Section 4.1.2.1, Vegetation; Section 4.1.3.1, Visual Resources; Section 4.1.3.5, Range; and Section 4.1.3.4, Timber.	The use is compatible with County plans in effect when the application was filed and present USFS plans with the exception of the Visual Management policies discussed above.
Employment, Population and Housing	Temporary construction activities are expected to average 48 workers over a nine-month construction period for each power plant. During operation, six new operators would be required for each power plant.	Schedule construction during the summer.	More housing would be available.
		Hire workers who already live in the area.	Demands for housing would be minimized.
Economics	In the unlikely event of depletion of geothermal water at Hot Creek Gorge and Hot Creek Hatchery, there would be a reduction in employment, retail sales, and rentals, increasing the severity of the unbalanced winter/summer tourist economy.	See mitigations recommended in Section 4.1.1.2, Water Quality and Hydrology.	These mitigations could eliminate impacts at Hot Creek Hatchery, except for the expenditures necessary to supply and mix the pumped water. Recreational bathing at Hot Creek Gorge would be lost if geothermal water did not reach the gorge.
	Demand for general county fiscal expenditures would increase due to the need for more community services by the increased residential population.	Increase local hiring. Adust application fees, charge fees for services, assess impact fees and user fees, and make maintenance agreements to cover costs.	Expenses to the County would be reduced.
	For both MP II and III, property tax revenues would increase by approximately $470,000 per year.	None is necessary.	
Community Services: School	Increased employment during construction and operation may result in an increase in overcrowding at elementary schools.	Assess an impact fee on power plant construction.	Additional funding for schools would be available.
		Use local labor.	There would be fewer new students.
Community Services: Sheriff	There would be potential for vandalism at the facility.	Power plant facilities and each well site should be enclosed with a chain-link fence to keep casual visitors away from equipment and operations.	Opportunities for vandalism would be reduced.
Community Services: Health Care	The health care services of Mono County are not expected to be significantly impacted during construction or operation of the facilities. However, local facilities are not equipped to handle victims of severe scalding or burns.	Follow the safety regulations as administered by CalOSHA. Drill wells in conformance with BLM requirements.	The risk of accidental injury or death would be reduced.
		Provide standard first aid supplies and instruct personnel on emergency procedures and locations of emergency supplies and services.	First aid would be immediately available.
		Insulate surface pipelines.	Risk of burn would be reduced.

Environmental Category	Major Impacts	Mitigation Measures (Keyed to Specific Impacts)	Expected Result of Mitigation
Community Services: (cont.)		Incorporate geothermal development emergency needs into County emergency response plan.	County agencies would be prepared for prompt response.
		Develop evacuation procedures for burn victims.	Burn victims would be properly treated.
Community Services: Fire	Construction activities would pose the danger of shrub or forest fires. During plant operations, the possibility that the isobutane working fluid might be released to the atmosphere poses a serious fire hazard.	Implement the fire control measures proposed as part of the project. See Section 4.1.3.2.4, Community Services.	The fire hazard would be reduced.
		Mammoth Pacific should submit a detailed fire protection plan to the Long Valley Fire Protection District and the Mammoth Lakes Fire Department.	Response would be coordinated, prompt, and appropriate.
		Contribute to construction of a fire station closer to the project.	Emergency response time would be shortened.
Community Services: Roads	County and USFS roads may be damaged by heavy construction traffic.	Establish agreements for the repair of damage to the County and USFS road systems caused by project activities.	The costs of road repair would be paid by the project sponsor.
Recreational Resources	There is a possiblity that the thermal springs at Hot Creek Gorge could be depleted as a result of operating the MP II & III plants.	No effective mitigation can be recommended.	A unique recreational resource would be lost.
	The California trout stocking program would be adversely affected if the temperature of water used at Hot Creek Hatchery were lowered by more than 2°F.	See Aquatic Resources, Section 4.1.2.3, and Economics, Section 4.1.3.2, for discussions of hatchery operations.	The mitigations suggested could restore the trout stocking program but would further deplete the geothermal reservoir and would require an investment in equipment.
	A spill of geothermal fluid may temporarily, adversely affect fishing in Hot Creek.	No mitigation is recommended beyond that in Section 4.1.1.2.3, Hydrothermal Resources, to confine the spill.	Confining the spill would minimize the impact.
	Recreationists driving, cycling, or jogging past the project area may be adversely affected by the noise and industrial appearance of the facility.	See Section 4.1.1.3, Noise, and Section 4.1.3.1, Visual, for suggested mitigations.	Impacts would be reduced.
	The power plants would attract attention.	Install an informational display.	The public would learn about geothermal resources and how they are used in Mono County.
Timber Resources	Merchantable-size Jeffrey pine would be harvested during the clearing of about 15 acres for the project.	Site well pads and pipelines in natural openings and clearings. Orient clearings which result from project development so that clustering of small non-merchantable trees is avoided.	The minimum amount of timber would be harvested.

Environmental Category	Major Impacts	Mitigation Measures (Keyed to Specific Impacts)	Expected Result of Mitigation
Timber Resources (cont.)		The operator should purchase all merchantable timber when harvested at prevailing market rate.	The timber owner would be compensated for harvested timber.
		Replant with natural vegetation wherever possible and fence revegetated areas.	The timber resource would be replaced.
Range Resources	Construction of the proposed MP II & III project would remove approximately 23 acres of range land from active use.	Revegetate all non-occupied cleared range lands. Fence revegetated areas to protect vulnerable plants.	Some of the range land would eventually be recovered.
Cultural Resources	Historic and prehistoric cultural resources may be adversely impacted by the proposed development.	Perform an archaeological assessment of the area to determine the exact areas that would be impacted.	Cultural resources would be protected or only slightly affected.
		Locate wells in areas where they would have no impact or a low impact. If the assessment indicates significant cultural resources in the area and no practical mitigation alternative exists, expensive data recovery investigations would be recommended.	
	It is possible that subsurface cultural resources may be encountered, damaged, and destroyed during construction.	Monitor development activities that may uncover buried cultural deposits. If cultural remains are discovered, halt land alteration in the vicinity and consult the Inyo National Forest Archaeologist. Adopt a course of action acceptable to the California State Office of Historic Preservation and the U.S. Forest Service.	Important subsurface cultural resources would not be significantly impacted.
	Cultural resources near the development may be indirectly adversely affected by increased use of the area.	Place locked gates on access roads which lead to culturally sensitive areas. Educate project personnel on the need to leave cultural remains as they are found.	Impacts on nearby cultural resources would be minized.
	The Bishop Elders have voiced concerns over resources important to Native Americans.	The project sponsor has agreed that Native Americans would have continued access to resources important to their culture.	Native American interests would be protected.
Transportation and Access	Heavy equipment used during construction could worsen traffic congestion at the Highway 395/State Route 203 interchange during busy periods.	Direct project traffic off Highway 395 to Hot Springs Road at the intersection south of State Route 203.	The potentially busy intersection would be avoided by project construction traffic.

2.0 INTRODUCTION, PROJECT DESCRIPTION, AND ALTERNATIVES

2.1 SUMMARY DESCRIPTION OF PROJECT AND ACCESS

Mammoth Pacific proposes to construct and operate a geothermal well field development project and two 12 MegaWatt (MW) (nominal) binary power plants known as Mammoth Pacific II and III (MP II & III). The development would be located on private and U.S. Forest Service (USFS) property in Section 32, T35N, R28E, Mount Diablo Baseline & Meridian (MDB&M), Mono County, California. The project area is shown in Figure 2-1.

The proposed development would be phased, with the MP II project completed and in operation before MP III would be constructed. The MP II power plant and its associated well field would include at least four production wells and at least three injection wells, all located on private land leased by Mammoth Pacific. The MP III plant site, also on private land, is adjacent to the MP II plant site; its associated injection and production wells would be on USFS land. Development of the MP III facility would depend upon successful operation of the MP II plant, a market for the additional power, and a determination that the geothermal reservoir would be adequate to support both facilities as well as MP I, the operating 10 MW plant just west of the project.

Access to the project area is via Highway 395 and State Route 203 to Hot Springs Road. Hot Springs Road (old Highway 395) leads to within approximately 700 feet of the plant site, which is reached by an existing dirt road. The proposed wells for MP II are all on private land and within 300 feet of existing dirt roads. The wells proposed for MP III are located on USFS land and are no further than 400 feet from existing dirt roads.

2.2 PURPOSE OF AND NEED FOR THE PROJECT

The purpose of the project is to develop and commercially operate two 12 MW (nominal, equivalent to about 10 MW net after the use of parasitic power within the plant) binary-cycle power generating plants with the attendant well field and transmission facilities. The project would use the geothermal resource of the Mono-Long

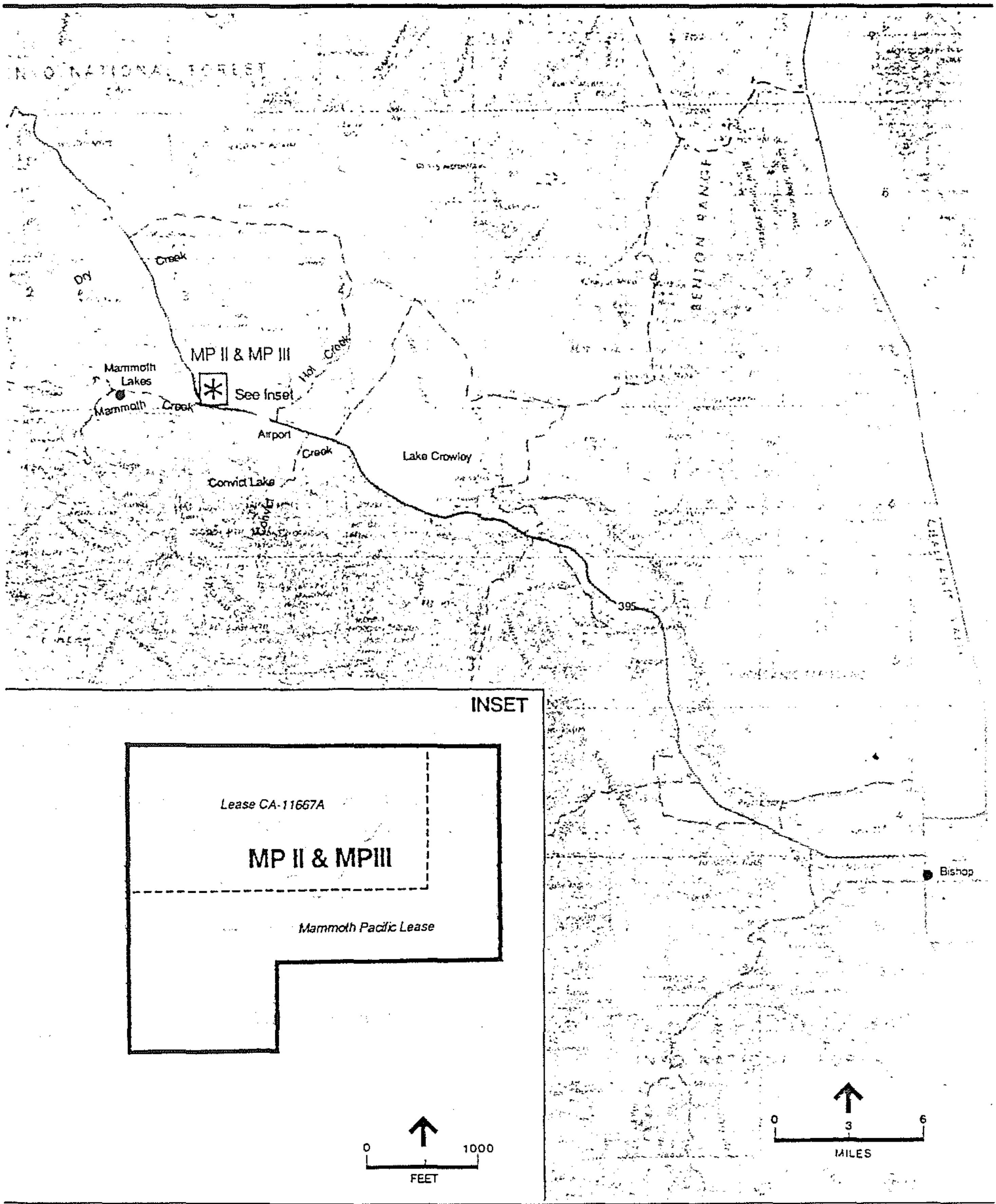


FIGURE: 2-1
Project Area

Valley Known Geothermal Resource Area (KGRA) to produce approximately 20 MW of locally generated power which would be fed into Southern California Edison's (SCE) existing distribution system. The power would be generated to add to SCE's base load capacity. It would not necessarily be used locally, because existing hydroelectric power supplies most of the local demand (Robinson, 1987). According to the California Energy Commission, SCE currently has adequate supplies of power, but will need additional capacity by the mid- to late-1990s in order to maintain reliability of the power supply (CEC, 1986).

Mammoth-Pacific has two power purchase agreements with SCE to purchase the power produced by the project. Mammoth-Pacific, consistent with orders by the California Public Utilities Commission, has proceeded to follow provisions of the Public Utility Regulatory Policies Act of 1978 (PURPA), which encourage development of qualifying cogeneration and small power production facilities. The purpose of the act is to encourage new technologies and reduce the nation's dependence on oil. Long-term renewable resources like geothermal reduce the need to operate fossil-fuel generating facilities. The existing Mammoth Pacific geothermal plant's power production saves approximately 156,000 barrels of oil per year and approximately $3.5 million over more expensive utility resources for power (Vinson, 1987).

For the parts of the project on U. S. Forest Service land, the need for the project is stated by Congress in the Geothermal Steam Act of 1970, the Mining and Minerals Policy Act of 1970, FLPMA of 1976, and the National Materials and Minerals Policy, Research, and Development Act of 1980. These acts direct the federal government to foster and encourage private enterprise in the development of alternative energy resources within appropriate environmental constraints. Toward this end, each lessee is required to perform ". . . diligent exploration until there is a well(s) capable of commercial production on the leased land." (43 CFR 3203.5). The lessee is also required to complete a commercial geothermal steam well within 10 years of the lease issuance or lose the lease.

2.3 BACKGROUND TO THE EIR: MAJOR ISSUES

Mammoth Pacific of Commerce, California, applied to the County of Mono in June 1986, for a Conditional Use Permit (CUP) for the development of the MP II & III project. The

Initial Study, first submitted with the application, was revised by the County on October 21, 1986. It indicates that the project may adversely affect the environment. Accordingly, the decision was made by the County of Mono to require an Environmental Impact Report (EIR). The Notice of Preparation (NOP) was issued by the County in November 1986. The Bureau of Land Management (BLM) is the lead agency for federal environmental review, and the EIR will also serve as an Environmental Assessment (EA) to satisfy their requirements.

Concerns expressed by agencies, organizations, and individuals who responded to the NOP deal with the following major issues:

- Geothermal Resources. The geothermal resource is important to Hot Creek Ranch and essential to Hot Creek Fish Hatchery and the recreational use of Hot Creek Gorge. It is unclear to what extent the geothermal reservoir for MP II & III and the source of the geothermal waters feeding Hot Creek are coupled, but if the temperatures of the springs at Hot Creek are lowered even a few degrees, it could have major impacts on the users of Hot Creek.

- Water Quality. The project area is within the watershed of Mammoth Creek and Hot Creek. Hot Creek is one of California's most important wild trout streams and also contains a popular swimming area in Hot Creek Gorge. Degradation of its water quality by sedimentation or release of large amounts of geothermal fluids would have serious consequences for the aquatic biota and for recreational uses of Hot Creek.

- Visual Resources. The Mammoth Lakes area is known for its scenic beauty, and preservation of scenic quality is important to the continued appeal of the area to visitors and residents. Some people feel that geothermal plants within clear view of Highway 395, a designated scenic highway, provide an incongruous industrial view out of keeping with the natural beauty of the area. Furthermore, one of the goals of the U.S. Forest Service is to decrease the visual impact of geothermal development along the Highway 395 corridor.

- Noise. The existing MP I geothermal plant is noisier than anticipated, and passers-by on Hot Springs Road are aware of its noise. The new plants will be required to meet noise standards enforced by Mono County.

- Deer Migration. Several thousand deer winter in the valleys south and east of Mammoth Lakes and have summer ranges either near Mammoth Lakes or in the high valleys west of the Sierra crest. Development at the site has the potential to disrupt the traditional migration routes of many of these deer.

- Economic Effects. The economy of Mono County is dependent on tourism, especially skiing. Development which would diversify the economy and provide increased revenues for the County could benefit the County and its residents. An assessment of the likely economic effects of MP II & III is provided herein.

2.4 REGULATORY FRAMEWORK

Discretionary approvals and permits from a number of agencies would be required for the project. These are summarized in Table 2-1. In addition, this EIR/EA has been prepared under CEQA guidelines in response to the County's requirements. As indicated in the Environmental Initial Study (see Appendix A), the project may result in significant environmental impacts. Furthermore, this document is intended to meet the requirements for an Environmental Assessment for use by the BLM in evaluating those parts of the project on federal land.

2.5 PROPOSED PROJECT

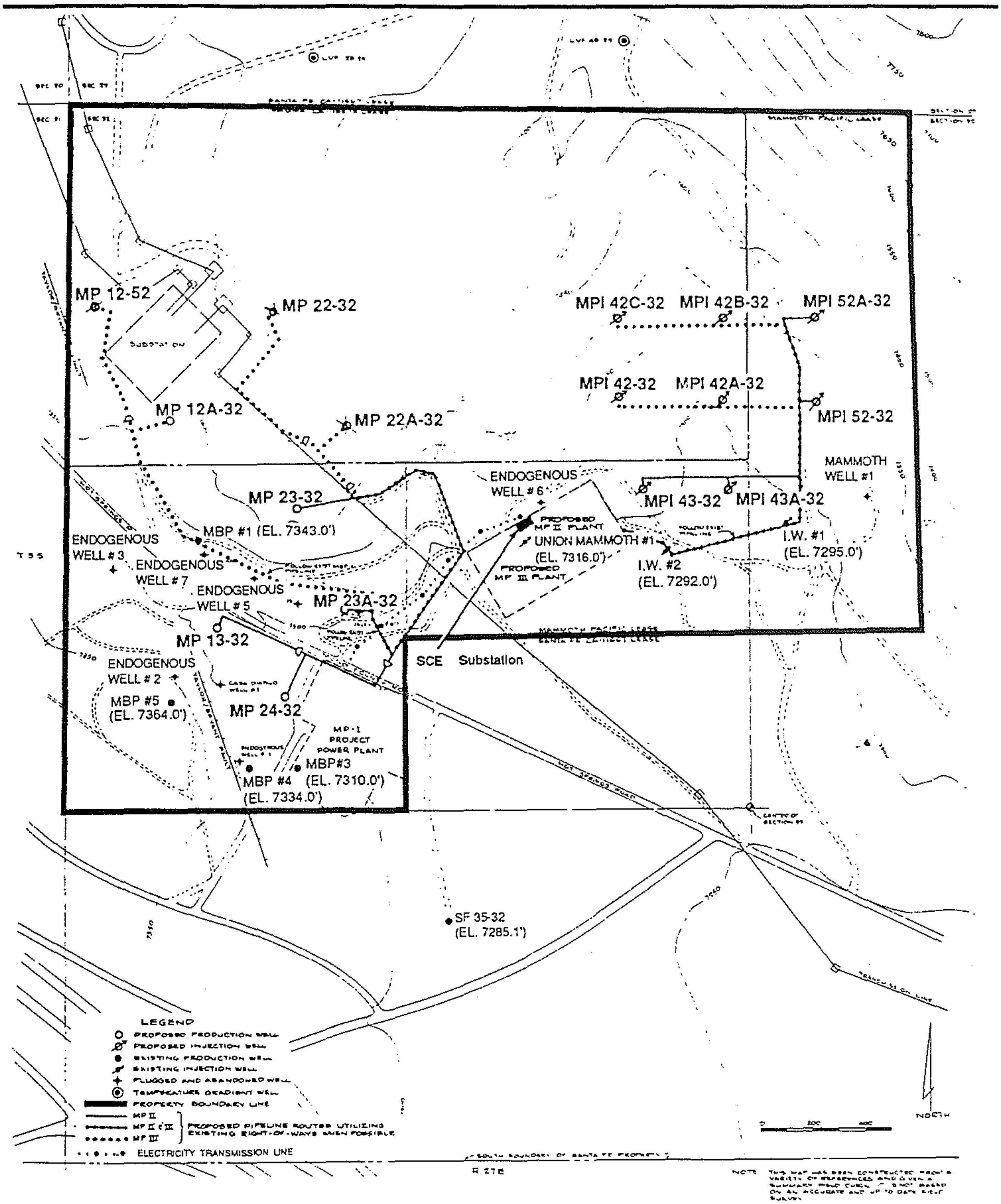
The proposed MP II & III project includes the phased development of two power plants and appurtenant facilities. Each would include the drilling and operation of production and injection well fields; the construction and operation of the related fluid conveyance production gathering system, injection distribution system, and surface infrastructure; and, the construction and operation of one 12 MW (nominal) binary power plant facility. MP II, the project to be first constructed, would include an electric transmission line leading from the power plant to the existing transmission line on Hot Springs Road. Geothermal fluid, produced from up to five geothermal production wells completed in the reservoir at an approximate depth of 500 to 700 feet for each power plant, would be directed by surface pipelines to the proposed binary power plant. After heat

TABLE 2-1: PERMITS AND APPROVALS

Agency	Permit/Approval	Facility
Mono County Office of Energy Management	Conditional Use Permit	Both power plants; wells on private land; transmission line; pipelines on private land.
Great Basin Unified APCD	Authority to Construct Permits to Operate	Both power plants; all wells. Both power plants; all wells.
California RWQCB, Lahontan Region	Waste Discharge Orders	Both power plants; all wells.
California Division of Oil and Gas	Notice of Intent to Drill	All wells.
Bureau of Land Management	Plan of Exploration Plan of Development Plan of Injection Plan of Baseline Data Collection Plan for Production	All wells on federal land.

SOURCE: Thomas, T. 1987.

extraction, the cooled geothermal fluid would be directed from each plant by surface pipelines to up to four geothermal injection wells and injected into the subsurface injection reservoir at an approximate depth of 2,000 feet. MP II would be completed and operational before the construction of MP III would begin. A total of eight production wells and eight injection wells is proposed for both phases of the project. Each plant would occupy approximately two acres. Approximately 34 acres of private land and 24 acres of USFS land would be used in the development and operation of well fields for the proposed project. Figure 2-2 shows the proposed well field and plant site locations. All the facilities for MP II would be on private land. The plant for MP III would be on private land, but the well fields are proposed to be located on USFS land. The design life of each plant is approximately 30 years.



SOURCE: Mesquite Group Inc., Oct. 1986

FIGURE: 2-2

Site Layout

Electrical energy produced by the utilization facility would be directed to on-site transformers. There it would be converted to the appropriate line voltage and delivered to the existing Southern California Edison (SCE) Company's Casa Diablo Substation, located approximately one-quarter mile northwest of the proposed sites of the MP II & III power plants.

Construction of each project would occur over a nine-month period. Site preparation, construction of concrete foundations, and preparation of pipeline supports would be done during the first two months of construction. Well drilling would begin in month three and last for four months. Installation of pipelines would begin near the end of month four and would be completed after eight months.

The project area is within the Mono-Long Valley Known Geothermal Resource Area (KGRA) and is approximately 600 feet from the existing 10 MW (gross, at 38°F ambient air temperature) MP I geothermal resource electric generating facility that has been operating since 1984. There are no other existing geothermal projects in the vicinity of the project.

2.5.1 PRODUCTION WELL FIELD AND GATHERING SYSTEM

Four production well locations are proposed for each of the MP II & III plants. They are identified on Figure 2-2 as well sites MP 13-32, MP 23-32, MP 23A-32, and MP 24-32 for MP II and well sites MP 12-32, MP 12A-32, MP 22-32, and MP 22A-32 for MP III. All well sites proposed for MP III are on USFS land. Well sites MP 12-32, and MP 22-32 and MP 22A-32 have been approved for exploration by the BLM.

The design requirement for each proposed plant is about 5,000 gallons per minute (gpm) of 330°F geothermal fluid. Four wells have supplied the existing MP I plant requirement of 3,800 gpm, which equates to an average rate of 950 gpm per well. Based on this average, five new production wells would be required for each new plant. A site for the fifth production well, if needed, has not been selected. The actual number of wells required will depend upon the drilling and flow test results. If well production is less than about 950 gpm, more wells may be required. The locations of additional wells which may be required are not shown in the site plan.

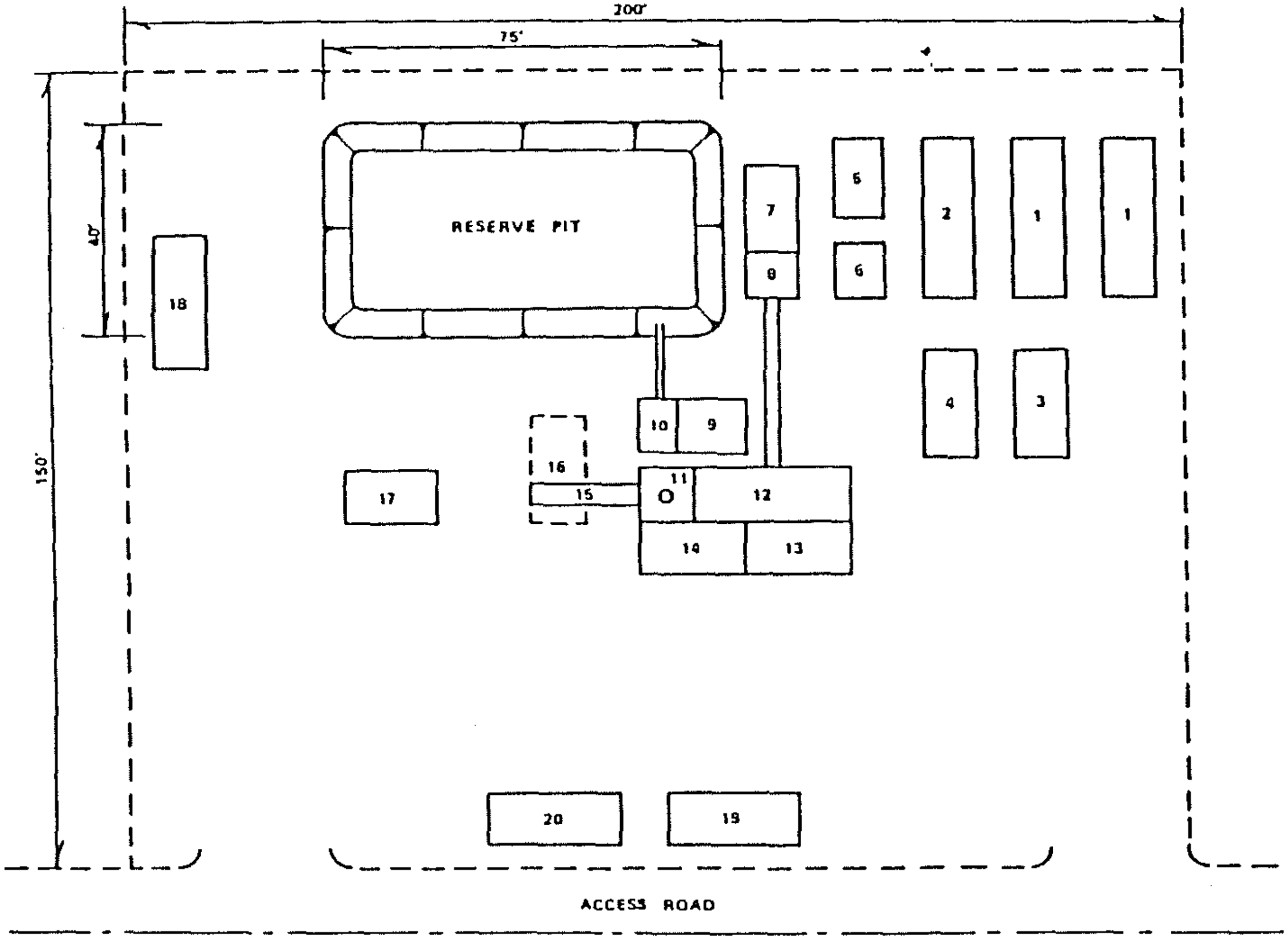
2.5.1.1 Well Drilling and Testing

At each proposed drilling site, a rig would move to a prepared pad. Each of the five pads would cover 0.5 to 0.7 acre. At each pad, there would be a 50,000 ± gallon capacity, plastic-lined reserve pit for the storage of waste drilling mud during the drilling period. A typical drilling pad and equipment layout is shown in Figure 2-3. Final equipment placement would depend upon the drilling rig used and the terrain.

The production wells are each designed to reach a total depth of 700 feet and would be completed in the fractured rhyolite geothermal reservoir. Well casing would consist of 30-inch conductor to 10 feet, 22-inch conductor casing to 80 feet, 16-inch surface casing to 350 feet, and completed with a 13-3/8-inch slotted production liner from 500 to 700 feet. All mud used during the drilling of each well would consist of a 8.6 to 9.0 pound-per-gallon weight gel. No hazardous or toxic mud additives are proposed to be used. A list of drilling mud additives considered non-hazardous by the California Department of Health Services is listed in Appendix B. A typical production well completion diagram is shown in Figure 2-4.

A longer-term flow test of each new production well would be conducted to more accurately determine well productivity. The test would consist of pumping the well for approximately five days through an on-site test facility closed to the atmosphere, and pumping the produced geothermal fluid through a temporary pipeline to the MP I power plant. There the fluid would be directed through the plant's cooled geothermal fluid system into the MP I injection reservoir. This is the same reservoir which would be used by MP II & III. The well test surface facilities and temporary pipeline would be removed when testing is completed.

Fewer than four production wells may be required, depending upon the drilling and flow test results. If any well drilled as a production well lacks commercial potential, a workover and/or deepening of the well may be conducted, or the well may be converted to an observation or injection well, or the well may be abandoned (including filling and capping).



1. Air Compressors
2. Mud Tank
3. Fuel Tank
4. Water Tank
5. Mud Storage
6. Generator
7. Change House
8. Accumulator
9. Mud Pit
10. Shale Shaker
11. Rig Floor
12. Draw Works
13. Storage
14. Dog House
15. Catwalk
16. Pipe Rack
17. Electric Logger
18. Mud Logger
19. Trailer House
20. Trailer Office

FIGURE: 2-3

Typical Drilling Pad and Equipment Layout

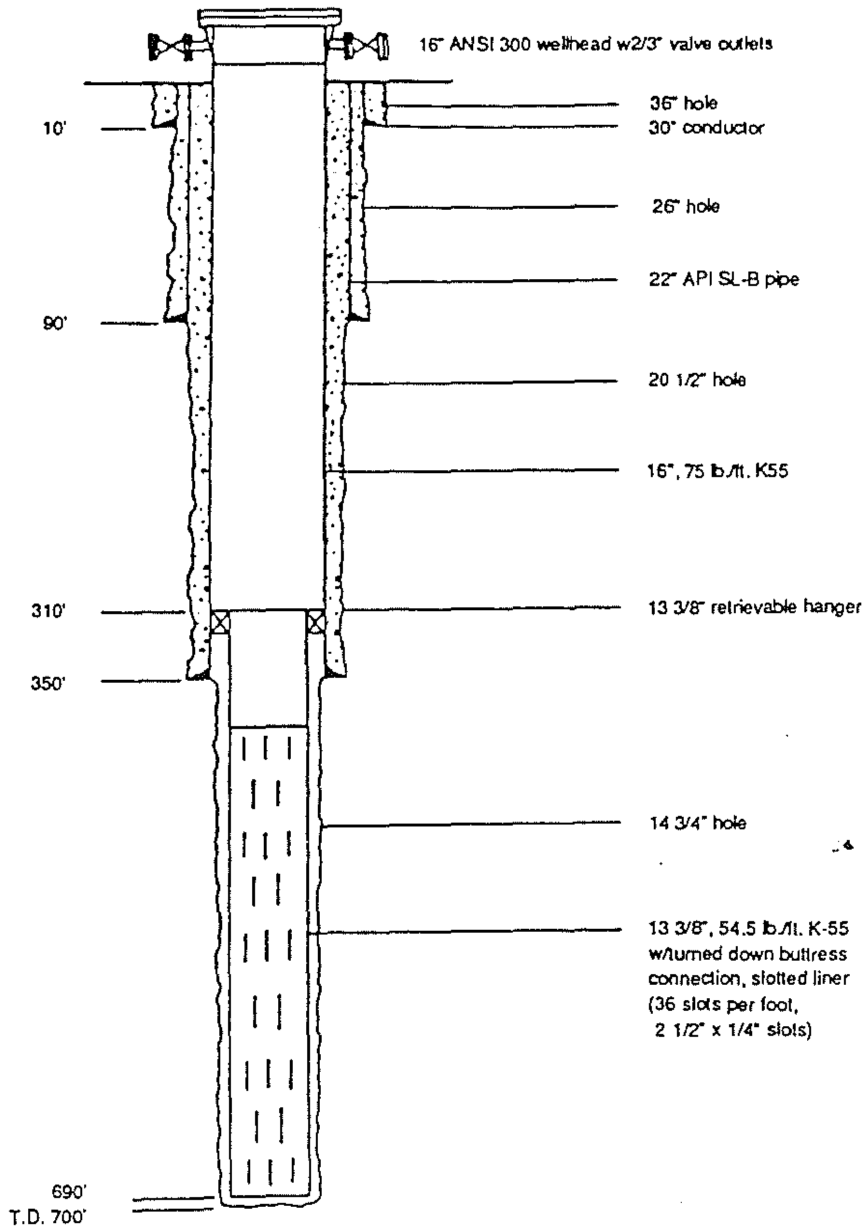


FIGURE: 2-4

Typical Production Well Completion Drawing

Each production well required by the project would require about 12 days of rig time to be drilled. At least one day with the rig on the hole has been allowed for well cleanup and initial flow testing into on-site tanks. The initial flow tests would be of short duration (approximately two to four hours).

2.5.1.2 Wellhead and Downhole Facilities

Each well would be pumped using a deep well, 12-stage, water or mineral oil lubricated, centrifugal, lineshaft turbine pump driven by a vertical electric motor located on top of the well. The electric motor, mounted on top of the pump discharge head, is not expected to exceed a height of 15 feet above the ground. A small control building (approximately eight by 15 feet), would be located within approximately 50 feet of each well, and would house auxiliary systems, motor switch gear controls and sensors, and transmitters for key temperature, pressure, and flow rate data. These data would be measured for purposes of process control, continuing resource data acquisition, safety, and environmental protection.

The production of hot geothermal fluid from each lineshaft turbine pump would be flow-rate controlled. Pressure limit sensors would also automatically shut down the pump in the event of an excessively high discharge pressure, which could damage the pump, or an excessively low discharge pressure, which might occur if a pipe ruptured. These and other automatic shutdowns would be equipped, as appropriate, with delays to avoid false shutdowns caused by momentary conditions, and would require overrides during startup.

Two auxiliary systems would be used. The first is a lineshaft bearing lubrication system which would pump lubricating fluid down the annular space between the lineshaft and enclosing tube. It is planned that the lineshaft bearings would be either water-lubricated or lubricated during pump operation by a flow of approximately two gallons per day (gpd) of a food-grade (biodegradable) mineral oil. The second auxiliary system is a closed-loop seal flush system which would be used to circulate a water/antifreeze mixture through the mechanical seal on the pump lineshaft at the surface.

2.5.1.3 Gathering System

The permanent gathering systems for transporting hot geothermal fluid from the wells to the power plants would use insulated pipelines routed as shown on Figure 2-2. Pipelines would vary in diameter from 10 to 14 inches. The size would be determined by the amount of fluid being carried. Horizontal expansion loops (approximately 30 by 30 feet) would be included within the pipeline every 250 to 350 feet. The pipelines would be located at or near ground level on concrete supports called sleepers and would be an appropriate color to blend with the terrain. Where appropriate, berming of pipelines may be used for visual screening. Downhole pumps in the production wells would deliver the geothermal fluid to the plant at about 200 pounds per square inch gauge (psig).

2.5.2 POWER GENERATION

The proposed power plants would use hot geothermal fluids produced from the geothermal production wells to generate electric power. Each power plant facility would be designed to produce a minimum of 10 MW (net) of electricity under normal operating conditions.

The power plant would use a closed-system binary process cycle to extract heat from the geothermal fluid pumped from the production wells. The geothermal fluid would not be flashed or exposed to the atmosphere at any time during its utilization. After heat is extracted from the produced geothermal fluid in the facility heat exchangers, the cooled geothermal fluid would be transported from the power plant by a surface pipeline to the injection well field facilities (see Section 2.5.3). Chemical treatment of the geothermal fluid prior to injection would not be necessary.

The project sponsor proposes to construct a radial flow turbo-expander binary Rankine cycle system which would extract heat from the geothermal fluid in shell-and-tube heat exchangers and transfer the heat to a hydrocarbon working fluid, isobutane in this design, explained below. The heated isobutane would be expanded through a turbo-expander generator system, converting the mechanical energy produced to electrical energy. Isobutane vapor from the turbine exhaust would be condensed in air-cooled condensers. The condensed isobutane would then be directed to a storage vessel (accumulator), from which the cooled and condensed isobutane would be pumped to start the closed-system binary cycle again.

The principal power generation facilities for the two plants would be constructed within an area approximately 300 feet by 560 feet, as depicted on Figure 2-2 which identifies the proposed location of all significant surface development, utilization and injection facilities, including: the production and injection well sites, power plant facility, access roads, interconnecting pipelines, associated structures, electric transmission line and on-site facility substation.

Figure 2-5 shows the power plant plot plan. The major equipment includes shell-and-tube heat exchangers, a turbo-expander generator, air-cooled condensers, isobutane accumulator, isobutane circulating pump, geothermal fluid injection pump, air compressors, gas freeing compressor, lubricant coolers, transformers, and electrical switchgear house. With the exception of the turbo-expander generator, these major plant components would not be enclosed in structures. The turbo-expander structure would be an open-ended enclosure with open sides about 10 feet above grade and will be approximately 40 feet square and 30 feet high to the roof peak. The two banks of air-cooled condensers would be used, each approximately 224 feet long by 60 feet wide with an overall height of approximately 30 feet. Each bank of condensers would contain 39 cooling fans.

The proposed shell-and-tube heat exchangers would occupy a space approximately 50 feet long by 20 feet wide and 20 feet high. The isobutane accumulator would be a cylindrical vessel approximately 70 feet long and 10 feet in diameter. The isobutane accumulator would be placed on supports along its length and would rest about five feet off the ground, thereby reaching approximately 15 feet in height.

A process flow diagram depicting the mass flows of both the geothermal fluid and the isobutane working fluid through the binary power plant is provided as Figure 2-6. Approximately 5,000 gpm of hot geothermal fluid for each plant would be pumped from the production wells through pipelines to the tube side of a shell-and-tube heat exchanger to heat the isobutane working fluid. The cooled (spent) geothermal fluid would not be exposed to the atmosphere during the cycle but would be pumped, if necessary, directly to the injection wells for subsurface disposal. The apparent loss of geothermal fluid volume indicated on the mass flow diagram results from the cooling of the fluid through the facility and does not result from consumptive use. There would be no difference in the fluid mass produced and fluid mass injected.

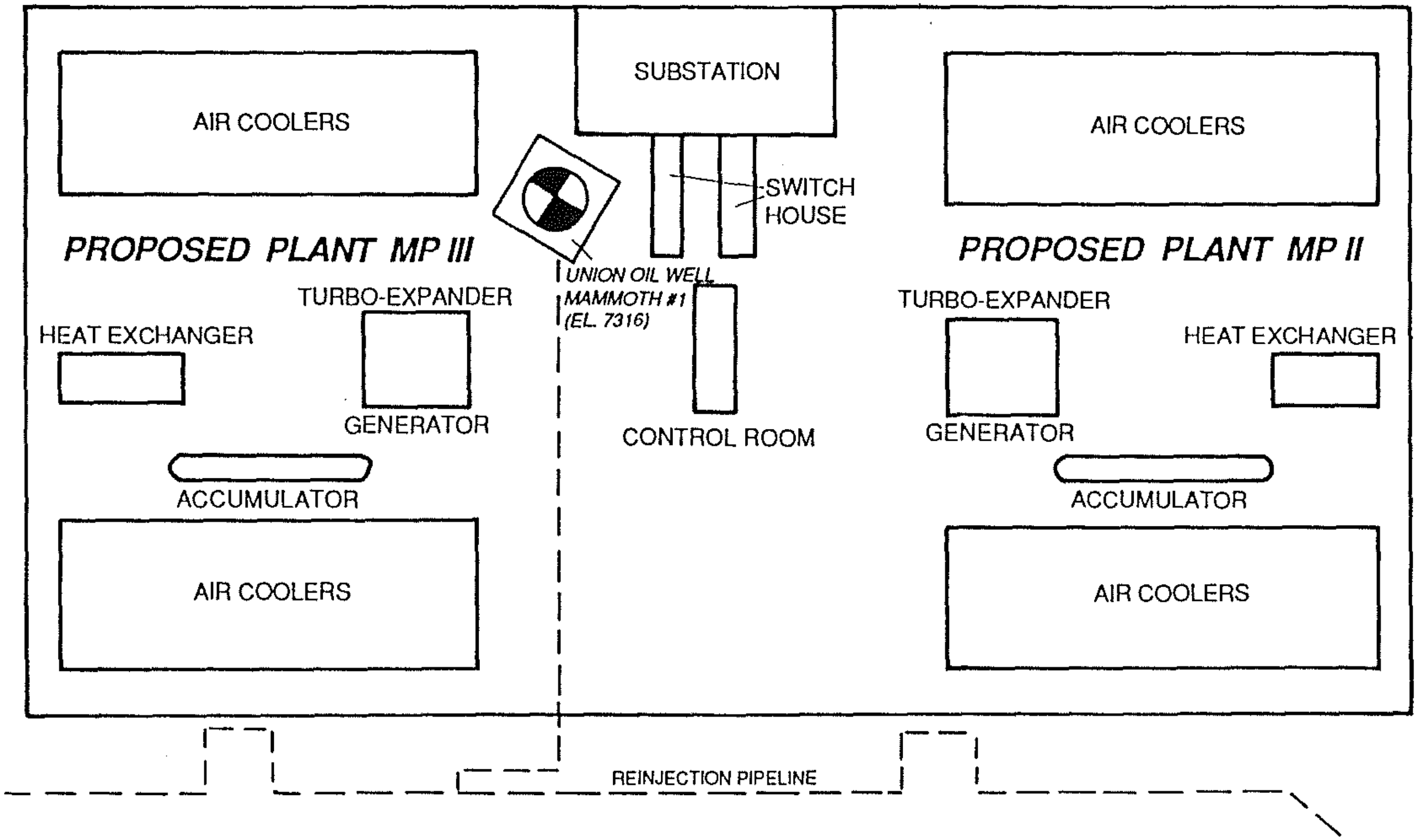
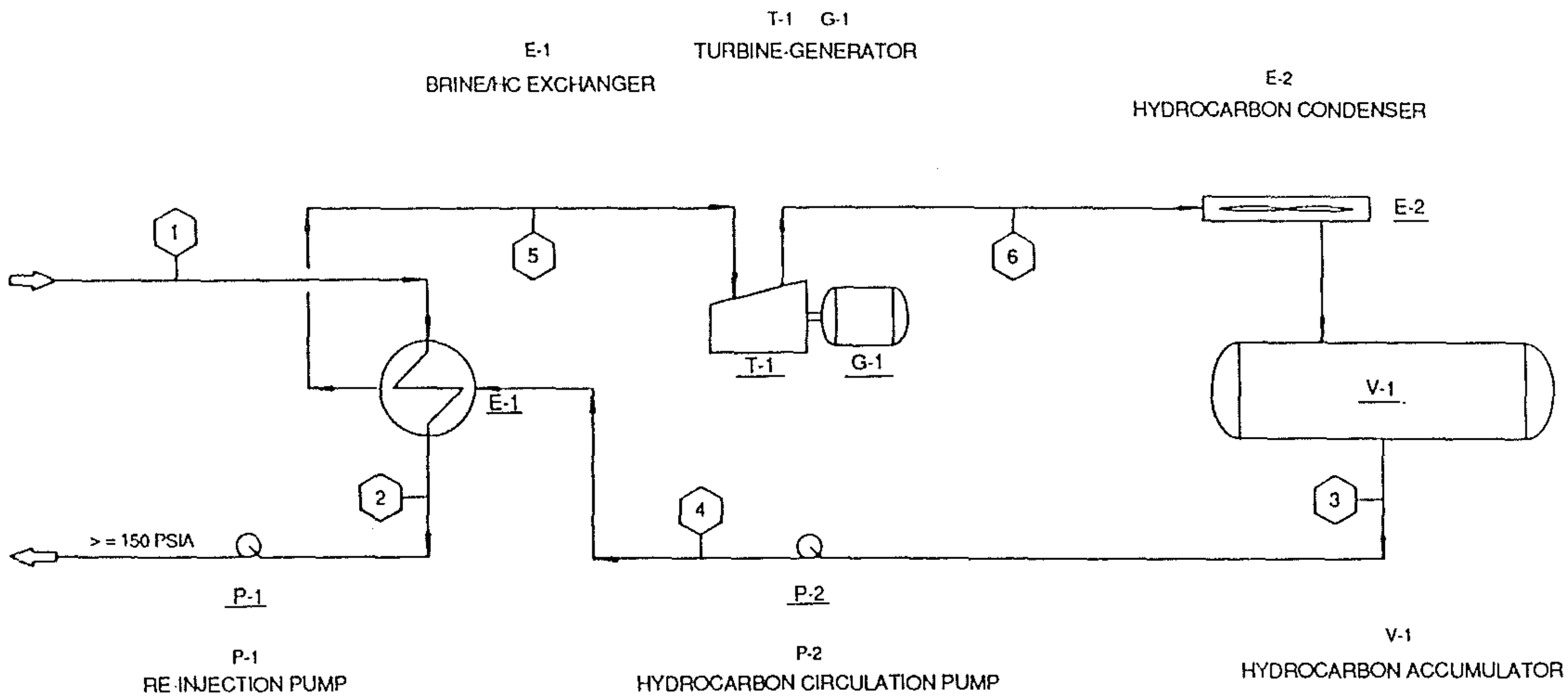


FIGURE: 2-5

Power Plant Plot Plan



STREAM NO	1	2	3	4	5	6
FLUID	Brine	Brine	HC	HC	HC	HC
FLOW 1000/HR	2,250	2,250	2,040	2,040	2,040	2,040
GPM	5,000	4,600	7,730	7,010	-	-
RCFM	-	-	-	-	4,090	48,000
TEMP (DEG F)	330	160	114	116	200	166
PRESS. (PSIA)	220	170	87	560	500	92
DENSITY	56.3	60.0	32.7	32.6	6.95	0.05
MMBTU/HR	665.2	302.0	0	6.0	368.4	325.0

10 MWe Net PLANT

GENERATOR OUTPUT	13,875 KW
PARASITIC LOAD (ONSITES)	2,625
BRINE PUMPING (OFF SITES)	1,250
NET	10,000 KW

FIGURE: 2-6

Process Flow Diagram

The equipment containing the isobutane working fluid would be protected from overheating and fire damage by a fire resistant insulation or cement. Such equipment includes the working fluid accumulator vessel, the working fluid-to-brine heat exchangers and the working fluid circulating pump suction lines. A fire water system with hydrants and fire hoses would also be installed to assist in cooling equipment, if necessary. The isobutane working fluid air-cooled condensers would be located on top of a steel supporting structure about 20 feet above grade. The structural steel columns and beams would be fireproofed against fire damage for two hours.

One building would be constructed to house the control room (CR) to serve both plants. The CR building would house the controls for the facility and space for plant operating personnel. The CR building would be a one-story structure approximately 20 feet tall and would occupy about 3,000 to 5,000 square feet. Both staff and facilities from the existing MP I plant would be used to provide clerical, administrative, and maintenance services for the MP II & III plants, so that new warehouse, workshop, and administrative facilities would not be constructed.

Water and sanitary disposal (septic) systems would be provided for the buildings. As there are no known potable water wells on the proposed power plant site, and as the site is outside the water service area of the Town of Mammoth Lakes, a water storage tank would be constructed to store water delivered to the site from either the existing MP I groundwater well located nearby or from a reverse osmosis treatment unit which would be constructed on-site to treat cooled geothermal fluid. The water storage tank would also serve as an emergency water source for safety showers and fire-fighting purposes. The water tank volume is estimated at 50,000 to 500,000 gallon capacity. Final tank volume would be determined during engineering design of the facility. There would be no consumptive water use for power plant cooling as air-cooled condensers would be used.

The expected potable water requirement for the facility, based on an estimated manpower requirement of six people, would be about 115 gallons per day. Bottled water would be furnished for drinking during construction and production operations.

The power plant facility area will be diked and drained to a catch basin, located west of the facility, of at least 250,000-gallon capacity. The catch basin would collect plant runoff and would be available for emergency spill containment. The entire use facility would be fenced.

All facilities will be constructed to meet or exceed applicable building codes and industry standards.

2.5.3 ELECTRICAL TRANSMISSION LINES

Generated electrical power would be transmitted from the facility substation to the Southern California Edison (SCE) Casa Diablo Substation, located approximately one-quarter mile northwest of the proposed MP II & III power plant site. The generated power will be transmitted via a new power line to the MP I plant, and then to the Casa Diablo substation via an existing power line (see Figure 2-2). The new power line would require six wooden poles and would be near existing roads.

2.5.4 INJECTION WELL FIELD AND DISTRIBUTION FACILITIES

Assuming that the MP I project ratio of three injection wells to four production wells is maintained, the proposed MP II & III project would require at least six injection wells. The proposed locations for eight injection wells are shown in Figure 2-2. Wells MPI 43-32, MPI 43A-32, MPI 52-32, and MPI 52A-32 would serve MP II and all would be located on private land. Wells MPI 42-32, MPI 42A-32, MPI 42B-32, and MPI 42C-32 would be used for MP III. They are located on U.S. Forest Service land.

2.5.4.1 Well Drilling and Testing Description

At each proposed drilling site, a rig would move to a prepared pad with a 50,000± gallon, plastic lined reserve pit for the storage of waste drilling mud during the drilling phase. A typical drilling pad and equipment layout would be similar to that discussed earlier for production well drilling (see Figure 2-3). Final equipment placement would depend upon the drilling rig used and the terrain.

The injection wells have been designed to reach a maximum depth of 2,000 feet and would be completed in the Bishop Tuff geothermal injection reservoir. Well casing would consist of 30-inch conductor to 10 feet, 22-inch conductor casing to 120 feet, 13-3/8-inch slotted liner to 1,000 to 2,000 feet. All mud used during the drilling of each well would consist of a 8.6 to 9.0 pound-per-gallon weight (ppgw) gel. No hazardous or toxic mud additives are proposed to be used.

Following well drilling, the well would be cleaned up and an initial flow test into on-site tanks will be conducted in much the same way as the production wells are tested. An initial injectivity test may also be conducted by injecting the geothermal fluid produced during the initial flow test back into the well. Finally, a longer-term flow test of each injection well may be conducted to more accurately determine the well's injectivity and/or productivity. This test would be similar to the longer-term production well flow test.

Fewer injection wells may be needed, depending upon actual drilling and injectivity test results. Expectations are that three injection wells for each plant may suffice, with the fourth well providing standby capacity. If any well drilled as an injection well lacks commercial injection potential, a workover and/or redrilling of the well may be conducted, or the well may be converted to an observation well or abandoned. If any well drilled as an injection well were to indicate commercial production potential, it could be converted to a production well and another injection well would be drilled to replace it.

2.5.4.2 Injection Pumps and Gathering System

Residual, cooled geothermal fluid from the plant would be pumped to the injection wells through insulated pipelines having diameters ranging from 10 to 14 inches. The injection pump would be an above ground, horizontal centrifugal pump driven by a variable speed electrical motor. It would be located within the power plant area and would be about five feet high by 10 feet long. The pipelines would be at or near ground level on sleepers and would be an appropriate color to blend with the terrain. Where appropriate berming of pipelines may be used for visual screening. Each well would be monitored as to injection rate, temperature and pressure in order to aid in process control and resource management.

2.5.5 ABANDONMENT

If operation of a well were to indicate that it no longer produces geothermal fluid in commercially viable quantities and is not suitable for reworking as an injection well, the well would either be abandoned or it could be used as an observation well. Abandonment of the well would entail specified procedures for plugging and capping that would:

- halt the flow of fluids and gases to the surface;
- prevent the contamination of groundwater resources and mixing of groundwater between aquifers; and
- avoid creation of safety hazards.

California Division of Oil and Gas (CDOG) procedures for plugging and abandonment would be strictly observed for wells on private property. Similar procedures are required under GRO Order 3 by the BLM for wells on USFS property. The deep portions of the well in the production zone would be plugged with cement. The casing would be cut off at least six feet below the ground surface and a steel cap would be welded on the underground casing.

The sumps would be drained of liquids and these liquids would be trucked to a reinjection well or, if toxic, disposed of at a Class II waste site. Muds would either be removed to a Class II waste disposal site or dried and buried in the sumps. Sumps would then be covered with native soils, contoured and revegetated. All equipment and structures at the pad would be removed. The pad site would be regraded and revegetated.

When the entire facility is ready for decommissioning after its approximately 30-year design life, the wells would be abandoned as described above under the procedures outlined by CDOG or the BLM. The plant itself would be decommissioned under guidelines established by the County in the CUP.

2.5.6 FIRE PROTECTION

During the construction phase all safety regulations would be followed and portable fire-fighting equipment capable of extinguishing small grass or paper fires would be maintained on site. The power plant would be designed in accordance with applicable Codes (e.g., 1976 and 1982 Uniform Fire Codes, California State Resources Code) and sound engineering practice.

The leak detection and monitoring program would include:

- addition of a gas odorant to each fill of hydrocarbon working fluid to facilitate leak detection;
- routine inventory analysis of hydrocarbon working fluid losses;
- periodic leak detection surveys with portable detection equipment;
- repair or replacement of significantly leaking equipment;
- installation of block vales and compressors to evacuate hydrocarbon working fluid from the system prior to maintenance operations; and
- use of hydrocarbon leak detection sensors and alarms.

In the event a working fluid leak is ignited, the equipment containing the working fluid would be protected from overheating and fire damage by a fire resistant insulation or cement. Such equipment includes the working fluid accumulator vessel, the working fluid to brine exchangers and the working fluid circulating pump suction lines. The working fluid air coolers will be located on top of a steel supporting structure some 20 feet above ground. The structural steel columns and beams will be fireproofed against fire damage for two hours. This is the standard petroleum refining practice where flammable liquids are handled. The power plant facility will be bermed for emergency spill containment.

It is standard practice to let a liquefied petroleum gas fire burn and protect the equipment. Isolation valves and drain piping are sometimes used to drain tanks, exchangers, etc., so that the burning time may be reduced. Where practical, this practice would be followed. Relief valves which discharge through pipes to a safe elevation would protect equipment from exceeding design pressures.

Fire control equipment would include: 1) water storage tank (estimated 50,000 to 500,000 gallon capacity); 2) fire pump and accessories, including: electric fire pump with batteries and charger, diesel fire pump with diesel fuel system, jockey pump controllers; 3) fire protection apparatus including: fire hydrants, monitors, and valves; fire hoses; automatic sprinkler for the control building; fire line pipes and fittings; and 4) fire alarm system, including; control panel, isobutane detectors, ultraviolet flame detectors, and ionization detectors.

Portable fire extinguishers would be installed throughout the plant area and in buildings for use on small grass or paper or refuse fires or smoldering situations as may arise. Standard first aid equipment would be on hand for any burn victims.

2.6 ALTERNATIVE PROJECT

The project sponsor has proposed an alternate power plant design using Ormat Energy Converter (OEC) units. An alternative location for the plant has also been proposed. Figure 2-7 shows the alternate site layout.

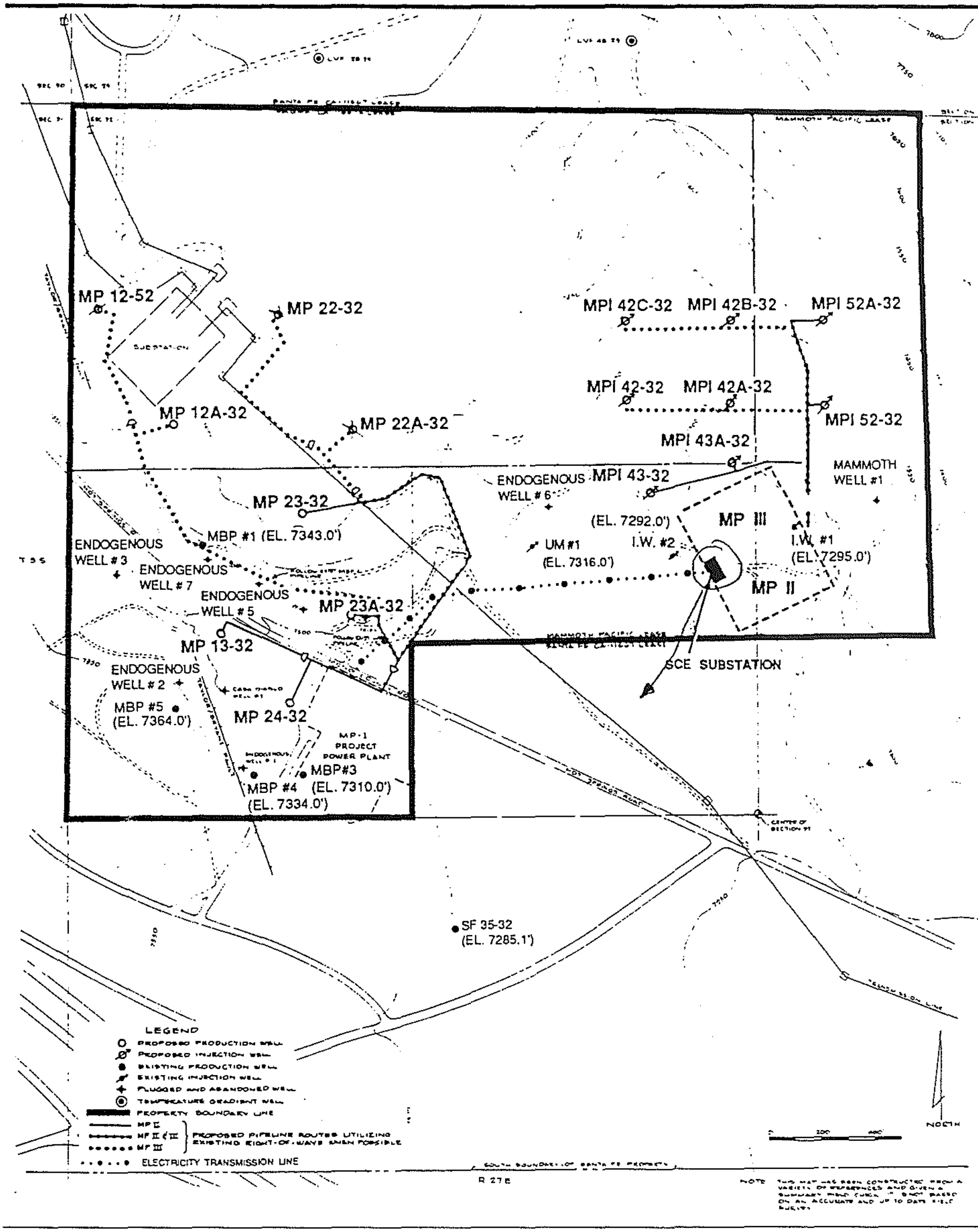
Other power plant features such as the control room, sanitary systems, and water supply system would be the same as for the proposed project.

2.6.1 WELL FIELD AND GATHERING SYSTEM

The production well field and gathering system would be the same as for the proposed project.

2.6.2 POWER GENERATION

Twelve modular binary heat extraction and turbine generator units, (OEC units), would generate electricity in a cascaded energy extraction system utilizing isopentane as the working fluid. Isopentane vapor from each OEC unit turbine exhaust would be condensed in air-cooled condensers. The condensed isopentane would be used in the closed-system binary cycle. The power plants would be constructed within an area approximately 340 feet wide by 580 fee as depicted on the Alternate Power Plant Plot Plan (Figure 2-8).



SOURCE: Mesquite Group Inc. and Environmental Management Associates, Inc.

FIGURE: 2-7
Alternate Site Layout

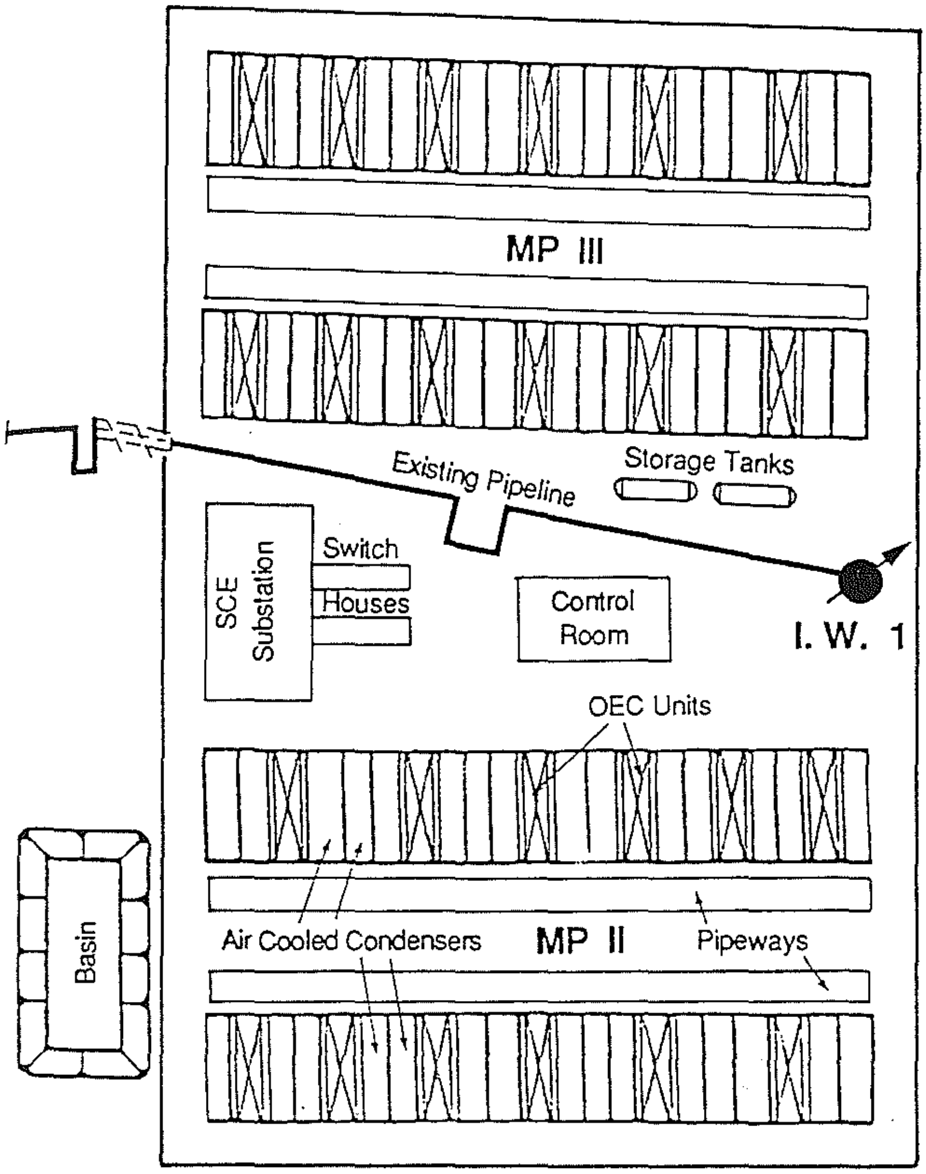


FIGURE: 2-8

Alternate Power Plant Plot Plan

The major equipment requirements are: twelve air-cooled OEC units (Figure 2-9); air-cooled condensers; isopentane accumulator(s); geothermal fluid injection pump; transformers; and electrical switchgear house. Each OEC unit consists of a turbine-generator, preheater, vaporizer, separator, and an isopentane feed pump. Each unit would be approximately 41 feet long by eight feet wide and ten feet high. The 12 OEC units would be arranged in two parallel energy cascade trains of six units each. Each cascade train of OEC units would consist of three Level I (high-temperature geothermal fluid) units, two Level II (intermediate-temperature geothermal fluid) units, and one Level III (low-temperature geothermal fluid) unit.

A bank of air-cooled condensers would cover each row of OEC units. Each bank of condensers would be about 320 feet long by 40 feet wide and 21 feet high and would consist of 22 individual condenser modules (three for each Level I unit, four for each Level II unit, and five for each Level III unit). Each condenser module would contain two cooling fans; thus, a total of 44 condenser modules and a total of 88 cooling fans would be used for cooling each power plant. No water would be used for cooling operations.

The isopentane accumulator would be one or more cyclindrical vessels approximately 45 feet long by ten feet in diameter. Each vessel would be supported about five feet above ground level. An estimated 20,000 gallons of isopentane for each power plant would be present in the modular turbine generator system.

A schematic Brine Cascade Diagram depicting total heat and geothermal mass balance through the modular system is shown in Figure 2-10. Approximately 5,000 gpm of geothermal fluid would be pumped from the production wells to each power plant. The production flow would be equally divided to the two rows of OEC units. Each OEC unit would independently convert mechanical energy to electrical energy in the turbine-generator system. The cooled geothermal fluid would be directed by surface pipeline to the injection well field for subsurface injection.

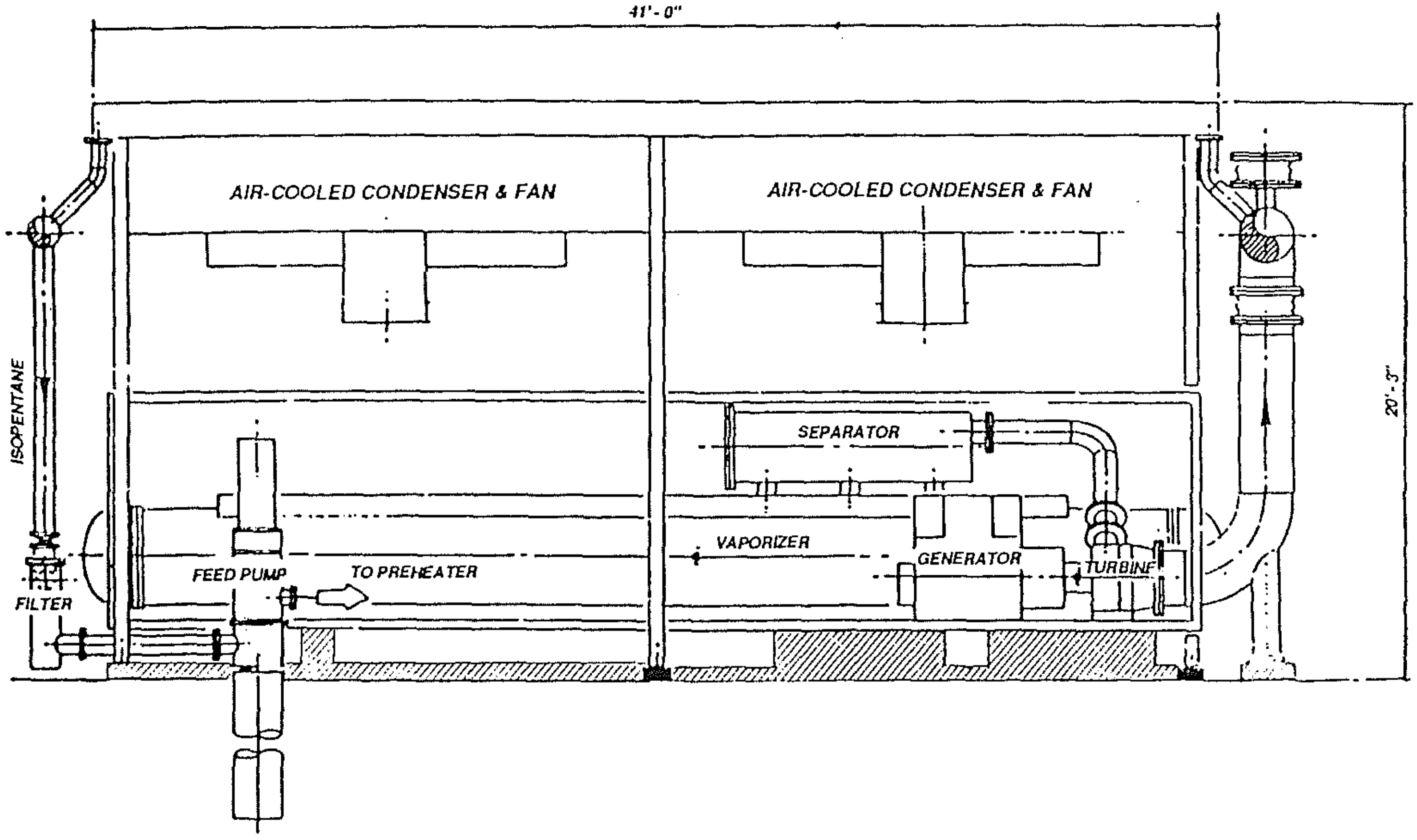
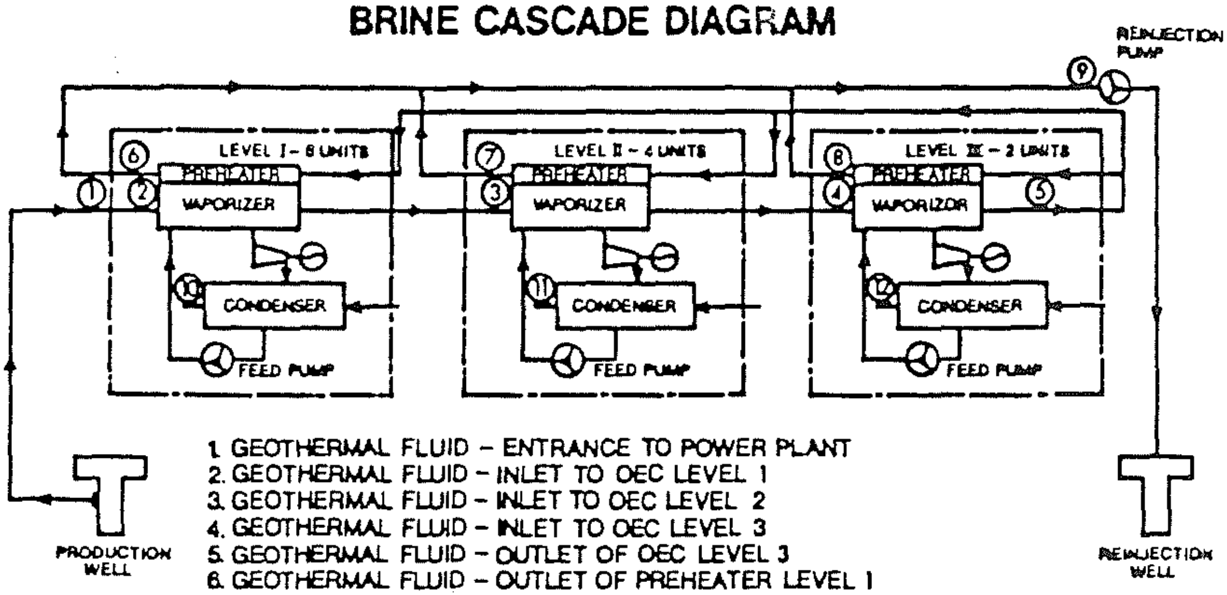


FIGURE: 2-9

Air-Cooled Ormat Energy Converter Unit

MODULAR TURBINE GENERATOR SYSTEM – BRINE CASCADE DIAGRAM



1. GEOTHERMAL FLUID – ENTRANCE TO POWER PLANT
2. GEOTHERMAL FLUID – INLET TO OEC LEVEL 1
3. GEOTHERMAL FLUID – INLET TO OEC LEVEL 2
4. GEOTHERMAL FLUID – INLET TO OEC LEVEL 3
5. GEOTHERMAL FLUID – OUTLET OF OEC LEVEL 3
6. GEOTHERMAL FLUID – OUTLET OF PREHEATER LEVEL 1
7. GEOTHERMAL FLUID – OUTLET OF PREHEATER LEVEL 2
8. GEOTHERMAL FLUID – OUTLET OF PREHEATER LEVEL 3
9. GEOTHERMAL FLUID – DISCHARGE TO REINJECTION PUMP
10. COOLING AIR – OUTLET OF OEC LEVEL 1
11. COOLING AIR – OUTLET OF OEC LEVEL 2
12. COOLING AIR – OUTLET OF OEC LEVEL 3

AIR TEMPERATURE – 50 DEG. F

	1	2	3	4	5	6	7	8	9	10	11	12
Flow Rate 10^3 lb/hr	2256	2256	2256	2256	2256	990	844	422	2256	19411	17254	10784
Pressure PSIA	220	215	205	190	175	165	165	165	160	11.3	11.3	11.3
Temperature Deg.F.	330	330	278	239	212	157	160	157	158	82.5	78	80

AIR TEMPERATURE – 87 DEG. F

	1	2	3	4	5	6	7	8	9	10	11	12
Flow Rate 10^3 lb/hr	2256	2256	2256	2256	2256	990	844	422	2256	19411	17254	10784
Pressure PSIA	220	215	205	190	175	165	165	165	160	11.3	11.3	11.3
Temperature Deg.F.	330	330	280	240	215	175	176	171	174.5	116.5	114	114

NOTE: EACH ORMAT ENERGY CONVERTER (OEC) UNIT OR MODULE IS A CLOSED AND INDEPENDENT ISOPENTANE CYCLE. THE OEC UNITS ARE NOT COMMON TO EACH OTHER

FIGURE: 2-10
Brine Cascade Diagram

2.6.3 ELECTRICAL TRANSMISSION LINES

The electrical power would be transmitted from the facility substation to the MP I substation via a new power line requiring approximately 10 to 12 wooden poles. It would follow an approximately straight line from the MP II & III substation to the MP I substation.

2.6.4 INJECTION WELL FIELD AND DISTRIBUTION FACILITIES

The proposed locations for eight injection wells are shown in Figure 2-7. Wells MPI 43-32, MPI 43A-32, MPI 52-32 and MPI 521-32 would serve MP II. All would be located on private land. Wells MPI 42-32, MPI42A-32, MPI 42B-32 and MPI 42C-32 would be used for MP III. They are located on USFS land. The location of MPI 43A-32 is slightly northwest of its location for the proposed project. Other well locations would be unchanged.

2.6.5 ABANDONMENT

Abandonment procedures for the alternative would be the same as for the proposed project.

2.6.6 FIRE PROTECTION

Fire protection procedures and equipment would be the same for the alternative as for the proposed project.

2.7 NO ACTION ALTERNATIVE

The No Action Alternative would prevent the construction and operation of the proposed MP II & III project.

3.0 AFFECTED ENVIRONMENT

3.1 PHYSICAL ENVIRONMENT

3.1.1 GEOLOGY, GEOLOGIC HAZARDS, AND SOILS

3.1.1.1 Regional Geology

The MP II & III site is located near Casa Diablo in the south-central part of the Long Valley caldera, an elliptical depression about 19 miles from east to west and 10 miles from north to south. The eastern half of the caldera is a broad valley with low relief. The western part, an embayment into the Sierra Nevada near the town of Mammoth Lakes, is an area of higher relief. A hilly area in the western-central part of the caldera, the resurgent dome, was formed of post-caldera rhyolite flows which have been uplifted and faulted. An annular moat is located between the caldera rim and the central resurgent dome (Sorey, 1987a).

Research done in the area has been summarized by Hill et al. (1985) in an article written to describe recent advances in understanding the Long Valley caldera. The following information, unless cited from another source, has been taken from that article. For more details and complete citations of original sources, the reader should refer to the article and its bibliography.

Volcanism within the Long Valley region began 3.2 million years (m.y.) ago when the Sierra Nevada Mountain Range began to rise. Early eruptions in the region were mostly basaltic, but near the present site of Long Valley caldera, more viscous materials like rhyolite were erupted. The roof covering the magma chamber erupted violently 0.73 m.y. ago and 144 cubic miles of magma was ejected mainly as ash. The ash deposits, known as the Bishop Tuff, covered more than 575 square miles. They reach thicknesses up to 5,000 feet deep within the caldera.

After formation of the caldera, continuing volcanic activity from the Long Valley system was confined to the caldera where the resurgent rhyolite dome was formed. Subsequent eruptions from the Long Valley magmatic system and the younger Mono-Inyo magmatic system resulted in a complex sequence of basalt to rhyolite flows within the annular moat. A geologic map of the area and an associated cross-sectional view across the caldera are shown in Figures 3-1a and 3-1b, respectively. The project area is near Casa Diablo, shown in both figures. The bedrock at Casa Diablo is basalt with the rhyolite from the resurgent dome immediately to the north. Alluvium and lake sediments overlie the rhyolite and basalt in some areas east of Casa Diablo.

3.1.1.2 Geologic Hazards

Long Valley caldera is one of the most seismically and volcanically active areas in California. Seven earthquakes greater than magnitude (M) 5.5 (see Figure 3-1 and Table 3-1) and hundreds of smaller events have occurred since 1978. During the same period, the resurgent dome has been uplifted. Researchers are studying the area intensively, but no consensus has been reached as to the exact cause of the earthquakes and renewed doming. There is general agreement that magma is moving upward under the resurgent dome and/or south moat. A variety of geological hazards, discussed below, are potential problems in such an area.

- Fault Rupture. The actual project site is within an area given a rating of "highest surface faulting hazard potential" in the Inyo National Forest Geologic Resource Inventory (Merrill and Seeley, 1981). That rating means that the site is within

TABLE 3-1: LONG VALLEY EARTHQUAKES OF MAGNITUDE 5.5 AND GREATER SINCE 1978

Event	Date	Magnitude
1	October 4, 1978	5.7
2	May 25, 1980	6.1
3	May 25, 1980	6.0
4	May 25, 1980	6.1
5	May 25, 1980	6.2
6	September 30, 1981	5.7
7	November 23, 1984	5.8

SOURCE: Hill et al. 1985. Journal of Geophysical Research.

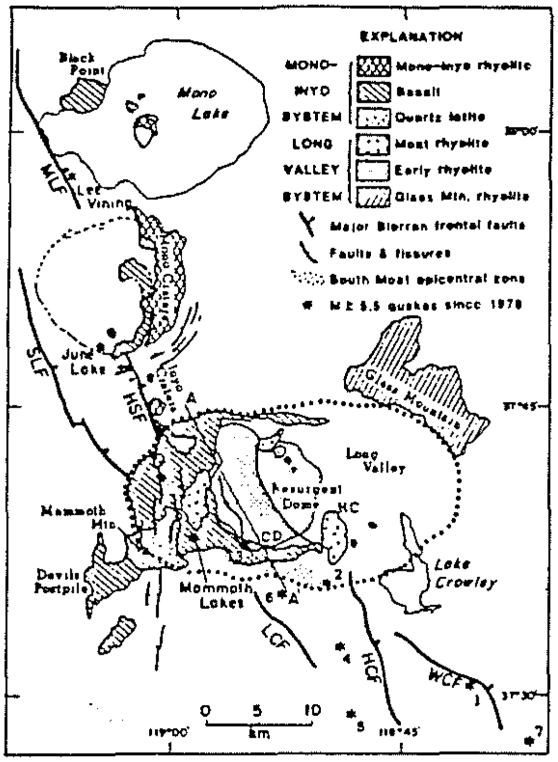


FIGURE 3-1a: Geologic map of Long Valley Region

HSF - Hartley Springs Fault
HCF - Hilton Creek Fault
LCF - Laurel Creek Fault
MLF - Mono Lake Fault
SLF - Silver Lake Fault
WCF - Wheeler Crest Fault
CD - Casa Diablo
HC - Hot Creek

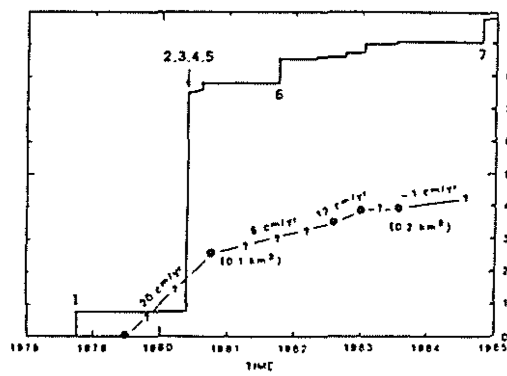


FIGURE 3-1c: Elevation History of benchmark near Casa Diablo Hot Springs and summary of seismic activity. Numbers refer to M > 5.5 quakes shown on Figure 3-1a.

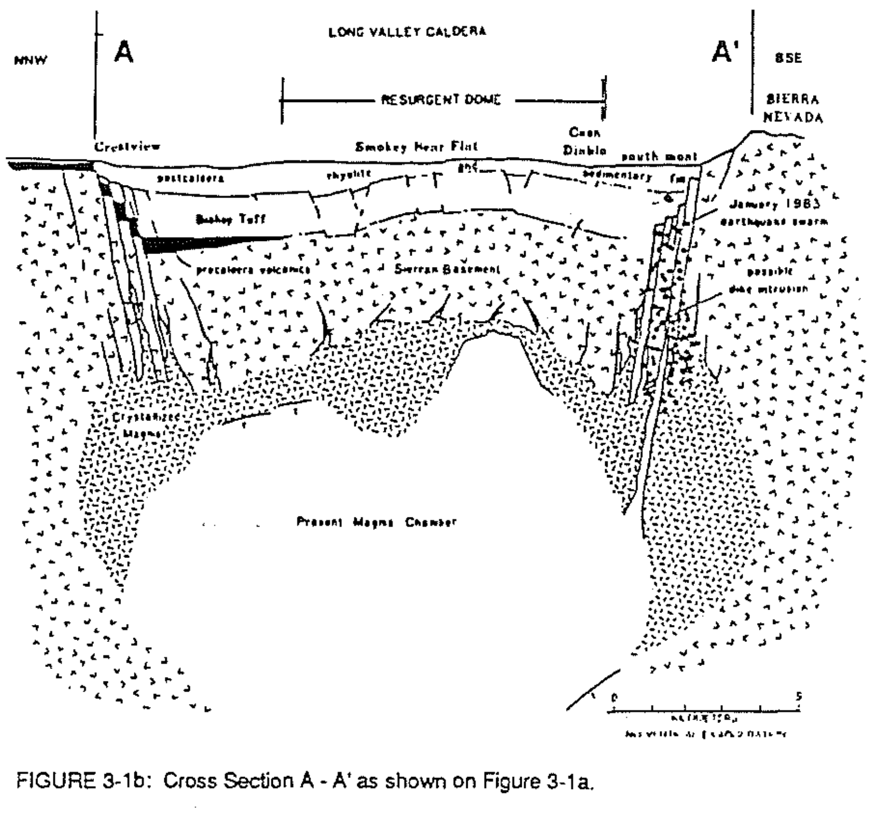


FIGURE 3-1b: Cross Section A - A' as shown on Figure 3-1a.

FIGURE: 3-1a, b and c

SOURCE: Hill et al., 1985, Journal of Geophysical Research

Analysis revealed highly erodible soils similar in character to those described above (Bureau of Land Management, 1986b). Because of their similar appearance and origin, it is assumed that the soils throughout the project area are similar in general nature to those which were sampled and that they are highly susceptible to erosion by wind, water, and vehicular traffic.

3.1.2 HYDROLOGY AND WATER QUALITY

The single most important concern about the development of geothermal projects in the Shady Rest-Casa Diablo-Hot Creek area is their potential for adversely affecting the flow of thermal water to Hot Creek. There is also the related concern that there may be a connection between shallow groundwater and the geothermal reservoir so that even the flow of non-thermal water supplying the springs at the headwaters of Hot Creek could be affected by pumping from the geothermal reservoir.

3.1.2.1 Models of the Geothermal Reservoir

The best way to answer questions about likely connections between different aquifers in the area is to have a "model" which accurately describes the distribution of heat, water, and steam. In this sense, a "model" is a working theory which describes, either mathematically or by analogy, how a process works when the process cannot be directly observed. Any model must be consistent with the observed characteristics of the area. The information available in the Shady Rest-Casa Diablo-Hot Creek area includes data about the temperature, flow rates, chemistry, and isotopic characteristics of water at some features in the area; but there is not enough information to definitively support one model of the system. Scientists working in the area have proposed two different models, both of which can account for the observed data.

The first model, called the Lateral Flow Model, is based on the assumption that the geothermal fluid originates near the western or southwestern edge of the caldera and moves east through the caldera. Under this model, the hot water would travel through the rhyolite reservoir until it encountered a fault. It would then migrate along the fault until it encountered rock with high enough transmissivity for the flow to be maintained. This model assumes a single hot water resource supplying all the thermal features in the area. The characteristics of the water at each feature would be the result of mixing thermal water and meteoric water in different proportions. This model implies that production of hot fluids from one zone and injection into another could result in pressure and/or temperature declines in nearby areas that depend on fluid from the same lateral zones.

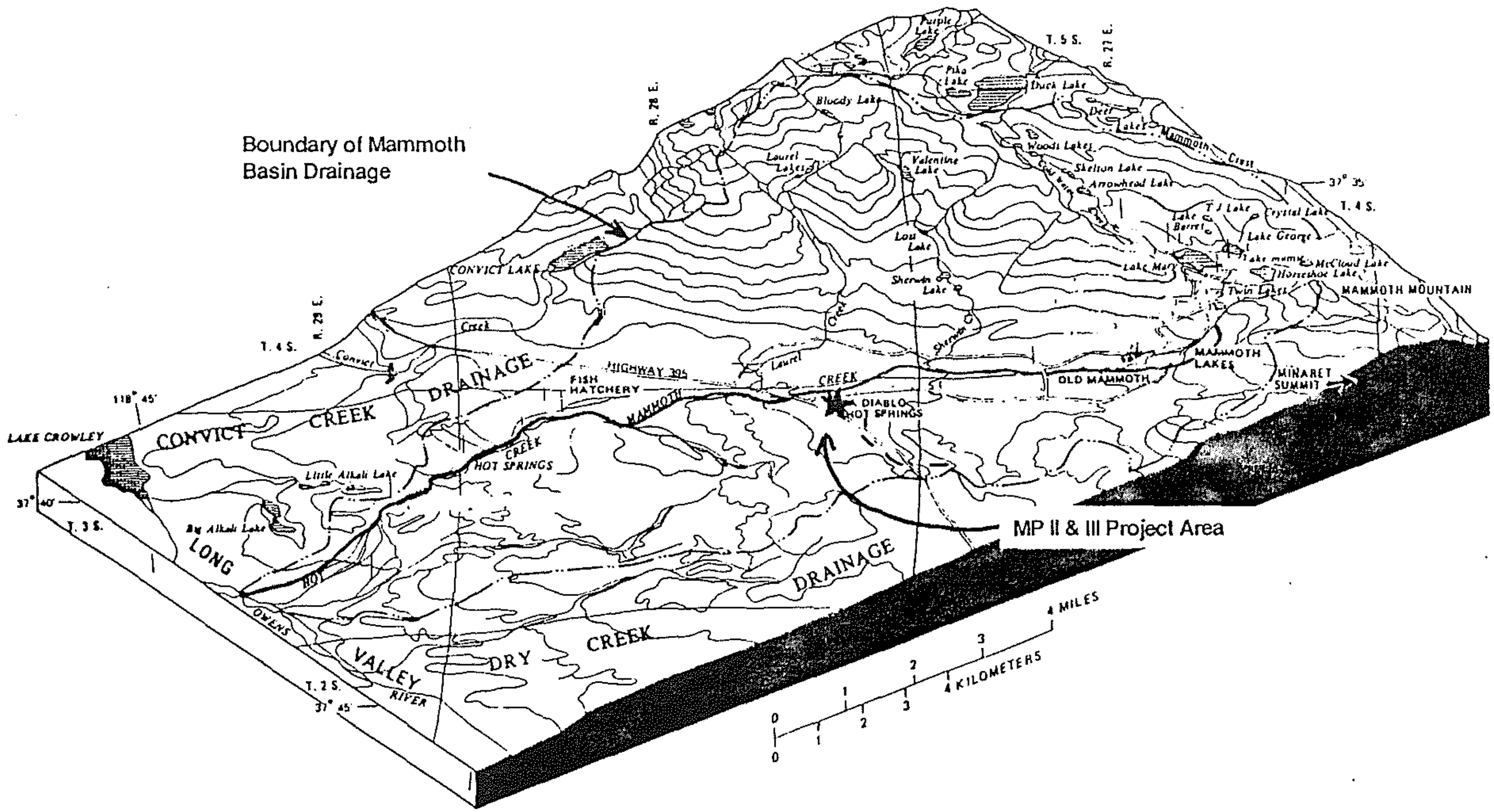
The second model is known as the Upwelling/Fracture Flow Model. Under the scenario proposed by this model, the nearly vertical faults which cut across the area serve as conduits to carry heated water up from deep reservoirs. This would suggest poor hydraulic connection between reservoirs for each thermally active area and little potential for interference between the Casa Diablo area and Hot Creek Hatchery or Hot Creek Gorge. A variation of the thermal upwelling/fracture flow model has been suggested (GeothermEx, 1986). Their model is one in which the fluids move from south to north, roughly along the strike of the major faults.

The following discussion of the surface and subsurface hydrologic resources briefly summarizes the current knowledge about the area. It is a summary of a report on the hydrology of the project area written by Berkeley Group Incorporated (BGI). The report is available from the Mono County Energy Management Department. Details and references can be found in the BGI report.

3.1.2.2 Surface Resources

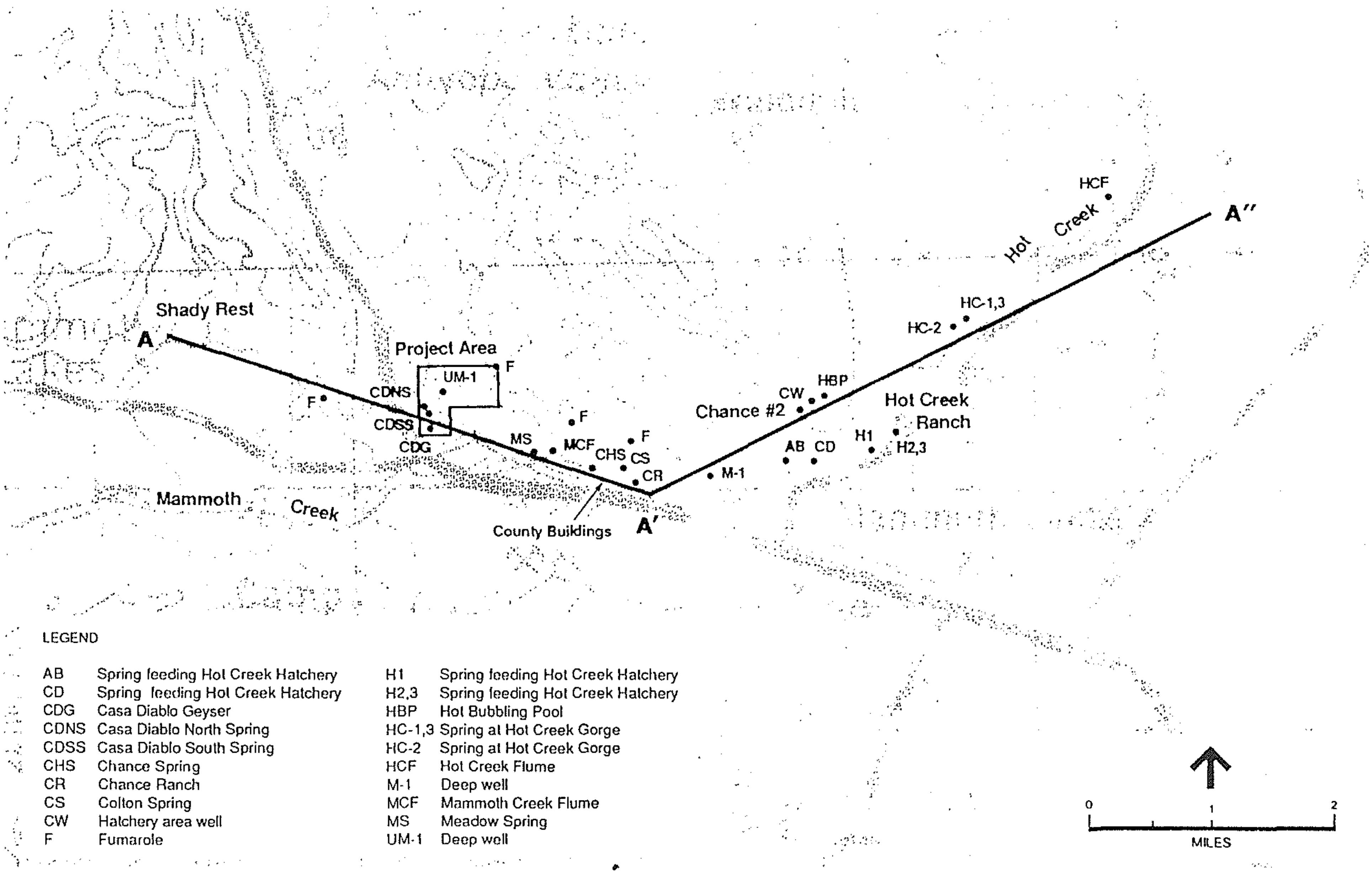
The project site is contained entirely within the Mammoth Basin, an area of approximately 60 square miles which is defined by the surface watershed of Mammoth and Hot Creeks. These creeks flow across the Long Valley caldera to the Owens River and then into Lake Crowley. Other small creeks draining the caldera include Dry Creek, Little Hot Creek, and Convict Creek. In addition to the creeks which drain the area, a number of springs contribute to surface flows. Locations of the creeks are shown on Figure 3-2. Springs and selected wells are shown on Figure 3-3. Flow data, temperatures, and water chemistry analyses are summarized in Table 3-3. The table gives average values which do not reveal seasonal changes.

The following discussion of surface hydrology describes these features: an unnamed creek which drains the project site, Mammoth Creek, Hot Creek, and five springs or groups of springs which ultimately flow into Hot Creek.



SOURCE: BGI, 1987

FIGURE: 3-2
Surface Drainage Features of the Mammoth Basin



SOURCE: BGI, 1987 and ESA

FIGURE: 3-3
Location of Thermal Features and Wells
in Southwest Long Valley

TABLE 3-3: AVERAGE FLOW RATE, TEMPERATURE AND CHEMISTRY DATA FOR PROMINENT SURFACE HYDROLOGIC FEATURES

Feature	Flow Rate (cfs)	Temperature (°C)	Total Dissolved Solids (mg/l)	Cl (mg/l)	F (mg/l)	B (mg/l)	Li (mg/l)	SiO_2 (mg/l)
1. Unnamed Stream at Casa Diablo	10	--	--	--	--	--	--	--
2. Mammoth Creek at Highway 395	35	10	--	0.1	--	--	--	--
3. Hot Creek Gorge Flume (HCF)	52	24	--	1.4	--	--	--	50
4. Casa Diablo Geyser (CDG)	0.35	91	1,350	290	13	12.5	3.5	300
5. Colton Springs (CS)	0.25	93	1,300	260	11	11.5	2.9	250
6. Fish Hatchery (H2,3)	5.1	11	112	2	0.25	0.009	0.004	36
7. Hot Creek Springs (HC-2)	--	82	1,140	220	10	10	2.6	140

SOURCE: CDWR, 1963; CDWR, 1974; Farrar et al., 1985; Farrar et al., 1986; and Setmire, 1984.

3.1.2.2.1 Creeks

Unnamed Creek Draining the Casa Diablo Area

The primary surface drainage feature in the project area is an unnamed tributary to Mammoth Creek. This creek originates near Highway 395 approximately 0.5 miles northwest of the project area and joins Mammoth Creek approximately 0.4 miles south of the site. The stream discharge rate varies seasonally from 0 to 40 cubic feet/second (cfs). Flow rate and fluid chemistry are dependent upon the relative contribution from the Casa Diablo Hot Springs. A significant, though unmeasured, amount of creek flow is believed lost into the thin alluvium between Casa Diablo and Mammoth Creek.

There is no known chemical analysis available of the Mammoth Creek tributary stream waters in the project area. The chemistry of the stream is likely to vary considerably depending upon the relative influx of hot spring waters. No consumptive use of the tributary exists.

Mammoth Creek

The flow in Mammoth Creek has been monitored since 1932 by Los Angeles Department of Water and Power (LADWP) at a flume (MCF) a short distance downstream from the inlet of the tributary as shown on Figure 3-3 (California Department of Water Resources, 1967 and 1973). Discharge rates vary between 3,000 and 40,000 acre ft/year at this point. A portion of the flow is lost to shallow ground water in the meadow between Highway 395 and Hot Creek Hatchery. An unknown quantity is diverted during summer months by a local rancher which may account for some (or perhaps all) of the loss.

The quality of water in Mammoth Creek is generally very good above Highway 395, but begins to degrade as hot springs discharge into it downstream (Setmire, 1984).

Hot Creek

Hot Creek originates in the meadow above Hot Creek Fish Hatchery where a group of springs emerge. The spring water is used at the hatchery and flows downstream in Hot Creek to its confluence with Mammoth Creek. Effluent from the hatchery contributes approximately 36 cfs to the flow of Hot Creek. This figure was obtained from measurements of flow rate at the springs. Actual flow rates may be higher if there are surface drainage contributions to the creek (Sorey, 1976; Farrar, 1985).

Hot Creek is monitored at the flume (HCF) below Hot Creek Gorge. This site has been used to gauge stream flow since 1923 and has most recently been used to collect data on the rate of discharge from the springs in Hot Creek Gorge relative to total stream flow. Stream flow at this flume varies between 25,000 and 80,000 acre ft/year and averages approximately 40,000 acre ft/year (California Dept. of Water Resources, 1967). Of this total, 7,000 acre ft/year (average 9.5 cfs) are contributed by hot springs along the gorge (Farrar, 1985).

Chemical analyses of samples taken at HCF indicate that most of the dissolved mineral load is due to discharge from thermal springs along Mammoth and Hot Creeks (California Department of Water Resources, 1967, 1973; Setmire, 1984). Under the present conditions, the water in Hot Creek at this point (HCF) has some contamination and may not be recommended for human consumption (Setmire, 1984).

3.1.2.2.2 Thermal Springs

Numerous hydrothermal features are found from the Casa Diablo area to the Hot Creek Gorge area (see Figure 3-3). These consist of springs of various temperatures and discharge rates and gas-emitting fumaroles. Some of these features maintain a relatively constant level of activity from year to year; others are intermittent and may change or disappear entirely.

Casa Diablo

There are several surface thermal features in the Casa Diablo area. The most prominent is the Casa Diablo Geyser (CDG), located immediately northwest of the MP I plant. The operators of MP I have cooperated with the monitoring of the springs and fumaroles by the U.S. Geological Survey (Farrar et al., 1985; Farrar et al., 1986). The results thus far show a distinct correlation between spring discharge and tectonic strain events, as shown by a large increase in flow rate three weeks before a nearby November 1984 earthquake of magnitude 5.8. Historical observations which date back to the late 1800s report a wide range of activity from "geysering" tens of feet high to no visible discharge (Lawrence Berkeley Laboratory, 1984). Estimates of total spring discharge vary from 0.35 to 1.4 cfs with most of the flow from the main vent (CDG). The temperature measurements range from 80°C to 90°C; the springs with low flow rates have lower temperatures than the springs which have higher flow rates. Some correlation is shown between existing geothermal well production/injection and the total discharge at CDG and two lesser springs. However, the historically variable flow at Casa Diablo makes the correlation difficult to quantify. When production at MPI began, the flow at CDG decreased some and briefly during Fall 1985, when production at MPI was interrupted, the geyser flow increased. The general trend over the past 2 1/2 years has been decreasing spring flow at Casa Diablo. In April 1987 CDG ceased to flow (Sorey, 1987b).

Hot spring fluids are characterized as sodium bicarbonate-chloride waters with a total dissolved solids content of 1000 to 1400 mg/l. The alkalinity of the CDG (382 to 469 mg/l) is between the alkalinity of the springs supplying Hot Creek Hatchery (70 to 110 mg/l), and the geysers at Hot Creek Gorge (471 to 490 mg/l). The data indicate that the chemistry of each spring is affected by discharge rate and temperature. Boiling near or on the surface concentrates constituents in the fluid, which may then partially re-mix with the condensate. Published analyses also indicate a complex relationship with possible mixing of cooler, less saline, shallow groundwaters (Mariner and Wiley, 1976).

Colton Spring Area

There are three groups of small springs located in the Colton Spring vicinity approximately one mile southeast of Casa Diablo along Mammoth Creek (see Figure 3-3). Their combined discharge is small and though there is no consumptive use, the discharge is now continuously monitored. The three springs differ markedly from each other in temperature and chemical composition and are of interest as indicators of the local hydrothermal system. Colton Spring (CS) is similar to CDG with respect to temperature and chemical species. Meadow Spring (MS) is cooler with low, intermittent discharge; chloride content and ionic ratios indicate that it could result from the mixing of water similar to CDG and local, near-surface groundwater. Chance Spring (CHS) is still cooler and has relatively high discharge. Its composition is closer to meteoric water than the other springs, suggesting a minor thermal water component.

Fish Hatchery Area

The four major spring groups in the hatchery area (AB, CD, H1, and H2,3) discharge from the edge of a basalt flow. These are the only sources of water for hatchery operations. The discharge temperature and chemistry suggest a small thermal component. If there is hydraulic continuity between thermal fluids produced and injected at Casa Diablo and the thermal component of the hatchery spring waters, then eventually reduction in temperature could result. No such indication is evident after two years of operation at the MP I power plant.

Discharge at each hatchery spring is relatively constant (±10%), measured at 12.7, 12.3, 6.2 and 4.8 cfs for AB, CD, H1 and H2,3, respectively. Temperatures from west to east in the same order are 16.0°, 14.0°, 12.8° and 11.1°C (Farrar, 1985; Farrar, 1986). Flow rates are estimated to rise 10% to 15% during the peak runoff season (May-June), which generally coincides with periods of high ground water recharge. Natural temperature fluctuations, of 1° to 2°C also occur. Effluent from all four springs at the hatchery contributes up to 40% of the flow in Hot Creek above the gorge.

Hot Bubbling Pool

Another surface feature of note in the area is Hot Bubbling Pool (HBP), located approximately one-half mile north of the hatchery (Figure 3-3). This spring-fed pool is of interest because its fluid characteristics are markedly different from the springs at Hot Creek Hatchery, yet its distance from Casa Diablo is approximately the same.

Because it may have a more direct connection to deeper thermal fluid, the HBP could serve as an ideal indicator of changes in subsurface conditions in that area, perhaps registering changes sooner and more dramatically than would be seen at Hot Creek Gorge springs or the Hot Creek Hatchery springs. No changes to temperature or chemistry at HBP have occurred which could be attributed to present power plant operations; thus, no connection between the two areas can be assumed at this time.

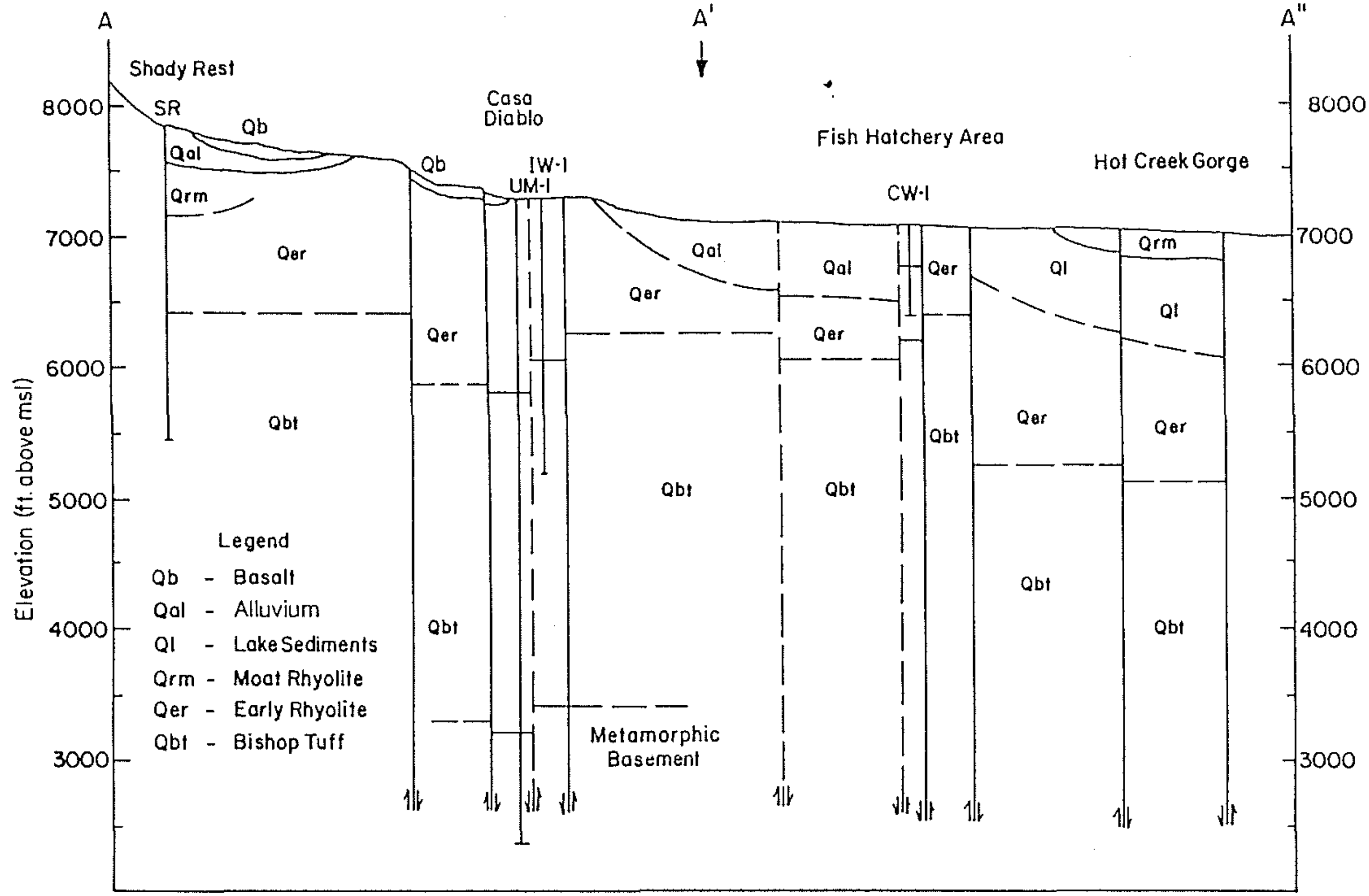
Hot Creek Gorge Springs

Several springs discharge at varying rates along Hot Creek Gorge (HC-2 and HC-1,3). Temperatures vary from 73° to 94°C. Total spring flow from this area cannot be measured directly since the major contributing vents are submerged in the creek bed. However, a close estimate of flow rate can be made from chemical flux correlations using the total flow of Hot Creek and its chemical load, measured at the USGS maintained flume (HCF) below the gorge (Farrar, 1985; Eccles, 1976; Sorey & Clark, 1981). Such calculations have yielded an average for total Hot Creek spring discharge of 9.5 cfs with a high of 11.6 cfs in 1980, attributed to recent seismic activity at that time. Increases in total flow, apparently due to tectonic strain, appear suddenly and slowly die off returning to normal flow patterns. The major vents are similar in chemical composition. The ionic compositions and ratios are comparable to the HBP and CDG, but the isotope ratios show significant differences. No changes in temperature, flow rate or chemistry have been seen in the Hot Creek Gorge springs as a result of the current MP I power plant operations.

3.1.2.3 Subsurface Resources

Drilling and geophysical studies in the Long Valley caldera have confirmed the presence of thermal fluids at various depths and locations in the south and southwest areas, including the Casa Diablo area and the project site. Deep drilling has been conducted at the Inyo Craters at the western edge and to east of the Hot Creek Gorge. The highest temperatures are found at Shady Rest (400°F) and Casa Diablo (350°F). Subsurface temperatures, depths, and water chemistry are summarized in the following discussion. Figure 3-4 is an idealized cross-section (along line A-A'-A" in Figure 3-3) showing the relative locations of geologic units, faults, and selected wells from Shady Rest to Hot Creek Gorge.

Subsurface hydrologic resources in the Casa Diablo area are characterized by a shallow localized cold groundwater at zero to 40 ft. depth, underlain by the main geothermal production zone at a depth of 300 to 600 feet with temperatures of approximately 330° to 350°F. A second thermal zone is found at a depth of 2,000 to 2,600 ft. (with temperatures about 305°F). The highest temperatures are found within the fractured rhyolite complex named the Early Rhyolite, located between zero and 1,500 feet in this area. The base of



SOURCE: BGI, 1987

FIGURE: 3-4
Geologic Cross-Section Showing Selected Wells

the Early Rhyolite also contains the cooler zone separating the upper and lower thermal aquifers. The Bishop Tuff is below the Early Rhyolite at an approximate depth of 1,500 to 4,100 ft. in the Casa Diablo area. This formation contains a second high temperature zone. Temperatures decrease steadily below this zone (Figure 3-4, Well UM-1). Well UM-1 has penetrated through the Bishop Tuff to the basement complex.

The major faults bounding the Casa Diablo area have apparently allowed the hot fluids to circulate closer to the surface than at other areas of the caldera. Higher temperatures are found in the Shady Rest well, but at greater depth than at Casa Diablo.

A recently drilled well (SF 35-32; see Figure 2-2) showed that higher static pressures are found south of the existing MP I wells in the area of the proposed PLES I development. Pump testing at rates of up to 2,100 gpm showed higher productivity than in the existing MP I production wells with a small pressure drop in SF 35-32 and no measurable interference with existing wells (Mesquite, 1986). Chemistry and temperature data suggest that the new well is producing from the same reservoir as the MP I wells.

3.1.2.4 Summary of Hydrologic Data

3.1.2.4.1 Pressure Data

Pressure measurements in wells currently used for production at Casa Diablo do not appear to be accurate enough for the detection of small scale trends. A proposal is currently under consideration to greatly improve the quality of such data (PLES, 1987).

Although the well test done at SF 35-32 (see Figure 2-2) is useful, data from other well tests do not allow analysis of small scale effects and do not provide reservoir parameters for calculations in this case. Therefore, pressure data presently cannot be used to evaluate the models.

3.1.2.4.2 Temperature Data

Temperature data from wells in the Casa Diablo area show a localized high temperature zone in the production interval at Casa Diablo. An isothermal zone exists at depths of about 1,000 feet in the Shady Rest well, and warm zones similar to those at Casa Diablo are found near the hatchery and Hot Creek Gorge. It is possible that fluid could be flowing laterally from Shady Rest through the Casa Diablo area to the Hot Creek Gorge area, cooling along the way. The assumption of the Lateral Flow Model would require fluids to move through or around major faults at Casa Diablo and across fault and stratigraphic boundaries toward Hot Creek Gorge. Such a path may be difficult to envision from the idealized cross-section of Figure 3-4. The extent of fracturing in the stratigraphic units would significantly influence fluid movement.

An alternative interpretation based on the Upwelling/Fracture Flow Model is that Casa Diablo and Hot Creek are recharged by upwelling fluids from different major faults. Surface infiltration into the alluvial layer (Qal) could explain the low temperature in well M-5.

Therefore, temperature data cannot be used to differentiate between the Lateral Flow Model and the Upwelling/Fracture Flow Model.

3.1.2.4.3 Chemical Data

Chemical analyses may be used to suggest the source of spring waters based on the characteristics of the discharge and subsurface water. These efforts at correlation have been based on comparison of prominent chemical species that are conserved during mixing and boiling, such as: chloride (Cl), lithium (Li), and boron (B) (see Table 3-3).

Cl/B and Cl/Li ratios indicate that the ionic ratios in various spring waters are comparable between the different thermal spring areas. The data also shows a trend of decreasing ionic concentration away from Casa Diablo, but with ionic ratios preserved (Shevenell, et al., in press). These data have been used to support the Lateral Flow Model describing a single source of fluids for the springs at Casa Diablo, Hot Creek Gorge, and Hot Creek Hatchery.

The stable isotope data for the same springs show large differences between the Casa Diablo springs, deep wells, and CDG. This suggests a more complex thermal fluid chemistry than is allowed by simply assuming dilution of thermal waters with non-thermal fluids. A combination of boiling and mixing of thermal and non-thermal fluids has been used to account for the isotopic data. These results were then used to support the Lateral

Flow Model based on a single fluid source. A simpler explanation has been proposed based on a multiple-source model, the Upwelling/Fracture Flow Model. The multiple fluid source model attributes differences in fluid chemistry between the thermally active areas to each having a different source of fluid that is upwelling from great depth.

At Casa Diablo, the chemistry of the reservoir fluids and the chemistry of the Casa Diablo springs, such as CDG are similar. In particular, the analyses of ionic ratios and stable isotope groups (regardless of the suggested degree of mixing by cold near-surface groundwater) show close agreement between data from the producing reservoir and surface springs. A preliminary analysis of fluid from the Shady Rest well also indicates a composition very similar to that of the Casa Diablo wells, but with a far higher calcium concentration, possibly due to the abundant calcium-rich deposits in fractures observed in the core samples. Differences in fluid chemistry of surface hydrothermal features eastward of Casa Diablo have been explained by a combination of boiling of geothermal fluids and mixing with water of meteoric composition (Sorey, 1987). There are exceptions; for example, the composition of fluids from the Hatchery Area Well CW requires mixing and boiling fractions that are different from the other wells to account for its ionic composition.

Currently, chemical data collected for several years from springs, and more recently from wells, can be used to support either of the current hydrothermal models to some extent.

3.1.2.5 Information Needed to Evaluate the Models

Overall, the proposed models of the hydrothermal system represent different views of fluid origin and movement of fluids in the southwest caldera region. Each has implications for the effect of future development at Casa Diablo on springs at Hot Creek Gorge and Hot Creek Hatchery. Currently, the chemistry, temperature, and pressure data do not provide definitive support for any of the models thus far proposed.

If it were not for the prohibitive cost and potential environmental impacts, many scientists working in the area probably would have extended their studies to allow more data to be collected which could result in a better understanding of the hydrothermal system. A list of research projects which may add to the data base could include:

- numerous core holes, stepping outward in several directions from Casa Diablo, completed to allow flow testing, sampling, temperature measurements and pressure monitoring;

- concrete containment structures for all springs to allow continuous and potentially more accurate measurement of spring flow and temperature; and

- detailed geophysical surveys in the south caldera region to focus on near surface (0 to 2,000 feet deep) fluid flow and geologic structure.

At present, there are environmental, financial, and technical constraints to pursuing these studies, so it is unlikely that a definitive model of the Long Valley caldera system will be forthcoming.

3.1.3 NOISE

3.1.3.1 Regulatory Framework

The Noise Element of the Mono County General Plan identifies goals and policies to attain and maintain acceptable noise levels. The Element requires an acoustical analysis prior to construction of any noise-sensitive land uses in areas that are currently exposed to a day-night equivalent noise levels (L_{dn}) of 60 dBA or more./1,2/ In addition, the Element requires an acoustic analysis for projects that would generate high noise levels in areas where existing noise levels are less than 60 dBA, L_{dn} (Mono County, 1981a). The Element also contains recommendations for mitigating noise, for new noise sources that exceed community noise compatibility guidelines.

Mono County Ordinance 79-479 limits construction and grading activities within 500 feet of residential or commercial occupancies to between 7:00 a.m. and 8:00 p.m. daily with Sunday construction activity allowed from 9:00 a.m. to 5:00 p.m. This ordinance is enforced by the Mono County Sheriff.

The U.S. Geological Survey, Conservation Division, has issued seven Geothermal Resources Operational (GRO) Orders. These operational orders have been adopted into federal regulation and pertain to all lessees on federal lands. Although these Orders are not specifically relevant to the MP II & III projects due to their proposed siting on private land, its guidelines may be used by local authorities to assess project impacts in lieu of more specific or timely local guidelines (Lyster, 1987b). GRO Order 4 calls for noise to be measured according to specific procedures with equipment that meets certain performance specifications. Attenuation of objectionable noise with muffling devices is also recommended. Under GRO Order 4, the lessee must comply with federal occupational noise exposure levels or State standards for protection of personnel, whichever is the most restrictive. Unless a more restrictive level is set by the authorized officer, the maximum noise exposure levels are set at an energy-equivalent noise level (L_{eq}) of 65 dBA for all geothermal-related activity as measured at the lease boundary or at 0.8 kilometers, whichever is greater (U.S. Geological Survey, Conservation Division, 1976)./3/

3.1.3.2 Noise Sources and Levels

Twenty-four-hour average noise levels were measured on the project site between the 8th and 11th of January 1987 (see Table 3-4). The major noise source in the project area is the MP I geothermal power plant located about 800 feet southwest of the proposed MP III site.

Operation of the MP I plant produces a continuous high-level hum which has been measured in excess of 100 dBA, L_{eq} within the facility compound. The 78 dBA, L_{dn} measured 150 feet from the plant during the January site visit (see Table 3-4) could causes a potential hearing loss hazard to those continuously exposed without hearing protection. Major sources of noise from the plant include the expander turbines, the air-cooled condenser fans, and the piping between the expanders and condensers. Noise control retrofitting of the MP I plant reduced noise levels by 10 to 12 dBA, L_{eq}. The muffling devices were subsequently removed, however, apparently due to faulty construction. A redesigned system with similar noise reduction potential will be installed at a later date. There have been complaints reported to the Energy Management Department about noise from the MP I plant (Lyster, 1987c).

Vehicular noise in the project area is negligible. Hot Springs Road, which passes to the southwest of the project area, is lightly traveled (no traffic counts have been taken since plant construction). The closest heavily traveled road is Highway 395, approximately

TABLE 3-4: 24-HOUR NOISE LEVELS NEAR CASA DIABLO HOT SPRINGS /a/

Site	Time Period	Noise Level dBA, L_{eq}	Noise Level dBA, L_{dn}/b/
MP I /c/	7:00 p.m. to 10:00 p.m.	75	
	10:00 p.m. to 7:00 a.m.	76	78
	7:00 a.m. to 7:00 p.m.	75	
MP II & III /d,e/	7:00 p.m. to 10:00 p.m.	60 (59)	
	10:00 p.m. to 7:00 a.m.	60 (60)	66 (66)
	7:00 a.m. to 7:00 p.m.	59 (58)	

/a/ All measurements were taken between January 8 and 11, 1987, with a Metrosonics model dB-306A Metrologger noise meter with wind screen, calibrated prior to each use.
/b/ The L_{dn} is based on the L_{eq}, but incorporates a 10-dBA penalty for noise levels measured between 10:00 p.m. and 7:00 a.m.
/c/ Measurement was made 200 feet south of Hot Springs Road and 150 feet east of the MP I plant boundary.
/d/ Increment was taken about 35 feet northeast of Union Mammoth Well No. 1.
/e/ Two measurements were taken at this site; the calculated L_{dn} for both measures was identical.

SOURCE: Environmental Science Associates, Inc.

0.5 miles to the west of the project site. Noise from this source was not audible during a January site visit by ESA staff, due to distance attenuation and noise from the MP I plant (see Table 3-4).

Intermittent aircraft noise is audible due to low-flying aircraft approaching and departing from the Mammoth/June Lakes airport about four miles to the east of the project site. Other sources of intermittent noise may be recreational vehicles (noise from which is controlled by the State Vehicle Code, Section 38365-A) and wood-cutting activities, which are controlled by use permits.

3.1.3.3 Noise-Sensitive Land Uses

The closest noise-sensitive concentrated land use is Sherwin Creek Campground, 1.5 miles southwest of the project site. The closest residence is at Chance Ranch, about 1.5 miles to the east. Residences at Hot Creek Hatchery are about three miles to the east-southeast. County office buildings are located about 1.25 miles to the east. The John Muir Wilderness Area is about 2.5 miles to the south of the project site. Dispersed recreational use (hunting, firewood gathering, target practice) occurs within one mile of the project site (see Section 3.3.3, Recreation).

NOTES - Noise

/1/ Noise is customarily measured in decibels (dB), units related to the apparent loudness of sound. Because the human ear is more sensitive to some frequencies than others, sound measured by an instrument (noise meter) is typically altered electronically so that it approximates what would be heard by the human ear. Units of noise measurement recorded by the meter are termed "A-weighted decibels" (dBA). Noise levels associated with some typical activities are listed below.

Sound Pressure Level (dBA, L_{eq})	Example of Source
110	Jet takeoff at 2,000 feet
100	Shouting in ear
90	Pneumatic drill at 50 feet
80	Freight train at 50 feet
70	Freeway traffic at 250 feet
60	Hospital incinerator at 50 feet
50	Quiet conversation at 10 feet
40	Rural environment at night
30	Soft whisper

SOURCE: Cuniff (1977) and Honour (1979).

/2/ Because environmental noise levels fluctuate with time, a time-averaged noise level in dBA is used to characterize the acoustic environment at a given location. The "day-night equivalent noise level" (L_{dn}) is a 24-hour time-averaged noise measurement to which a 10-dBA "penalty" is added between 10:00 p.m. and 7:00 a.m. to account for greater nighttime noise sensitivity.

/3/ The "energy equivalent noise level" (Leq), is the average noise intensity over a given period of time.

3.1.4 AIR QUALITY

3.1.4.1 Climate

Precipitation. The study area receives an annual average of eight to 13 inches precipitation, measured as rain. Higher elevations near the project site receive up to 80 inches of precipitation. Approximately 65% to 75% of the annual precipitation falls as snow.

The Pacific High, a persistent weather system located off the coast of California, strongly influences regional weather. In the summer, it deflects the westerly movement of storm tracks to the north, which results in mild dry weather at the project site. When the pressure system moves south in the winter, westerly storms can move across the state. These storms typically carry moisture-laden air up the Sierra Nevada and produce heavy snowfalls.

Temperature. Summer daytime temperatures range from 65° to 90°F. Nighttime temperatures range from 37° to 55°F. Winter daytime temperatures average 25°F, with nighttime lows dropping as low as -20°F.

Wind. In the summer, when the Pacific High prevents westerly storm tracks from reaching the Sierra Nevada, wind patterns are determined primarily by local topography. Temperature differences between warm valley floors and cooler upper slopes create upslope daytime winds and downslope evening breezes that can reach five to 10 miles per hour (mph). During occasional thunderstorms, winds are from the south and southeast. In the winter, wind patterns are due primarily to storm systems moving through from the west. Wind speeds typically reach 10 to 20 mph, with gusts from 40 to 70 mph.

Temperature Inversions. When air temperature increases with height, vertical mixing and dispersion of pollutants is inhibited. The mixing height is the level to which pollutants can be dispersed in the atmosphere; typically this is the height of the base of the inversion layer. Estimated daily mixing heights for the study area, derived by Holzworth (1972), are shown in Table 3-5. These heights indicate that the area is moderately prone to inversion-related pollutant concentrations, with the lowest mixing heights occurring on autumn mornings.

3.1.4.2 Existing Air Quality

The project site is within the Great Basin Valleys Air Basin (Alpine, Mono, and Inyo Counties), which is administered by the Great Basin Unified Air Pollution Control District (GBUAPCD). Air quality in the project area has been monitored by the GBUAPCD in cooperation with the California Air Resources Board (ARB), since 1979. Four criteria pollutants (those for which the U.S. Environmental Protection Agency has established ambient air quality standards) have been monitored in the Mammoth Lakes area: total

TABLE 3-5: DIURNAL MIXING HEIGHTS, BY SEASON

Season	Mixing Height (feet above surface)	
	Morning	Afternoon
Winter	1,300	3,300
Spring	2,200	8,000
Summer	1,000	8,600
Fall	800	6,300
Annual Average	1,300	7,300

SOURCE: Holzworth, 1972.

suspended particulate (TSP), particulate matter 10 microns or less in diameter (PM_{10}), carbon monoxide (CO), and ozone (O_3). In addition, hydrogen sulfide (H_2S) has been monitored on a short-term basis. Other pollutants typically of concern in urban areas are nitrogen oxides (NO_x), sulfur dioxide (SO_2), lead (Pb), and volatile organic compounds (VOC) hydrocarbons. Concentrations of these contaminants have not been regularly measured in the project area. In 1974, the ARB made a special study of Pb, NO_x, and VOC and determined that NO_x and Pb standards were being met, and that violations of the VOC standards were infrequent.

TSP and PM_{10} Sources and Levels. Suspended particulate results from wind erosion of exposed soil, from combustion of fuels, and from the movement of vehicles. The ARB redefined the TSP standard in 1985 to apply to "inhalable" particles only (those less than 10 microns in diameter, PM_{10}). PM_{10} has been measured since 1984 by air pollution control agencies because it causes more serious health effects than larger diameter particulates. The arid climate, high winds, and exposed shorelines of regional lakes (Mono, Crowley, and Owens) combined with the use of wood-burning stoves, fireplaces, cinders (for vehicle traction), and vehicle travel, result in high TSP and PM_{10} levels in the project area. TSP data collected in the Mammoth Lakes area are shown in Table 3-6.

TABLE 3-6: TOTAL SUSPENDED PARTICULATE MATTER IN THE MAMMOTH LAKES AREA 1981-1985/a/

Station	Averaging Period	Standard/a/	Total Suspended Particulate Matter Concentrations (ug/m^3) 1981	1982	1983	1984	1985
Mammoth Lakes High School	24-hour	100	219	230	263	ND	ND
	Annual	60	54.0	52.2	149.5	ND	ND
Fire Station	24-hour	100	787	496	425	806	345
	Annual	60	146	90.1	72.7	73.8	72.1

/a/ State standards not to be equaled or exceeded. The 24-hour national primary standard is 260 ug/m^3, the secondary standard is 150 ug/m^3. The annual average primary standard is 75 ug/m^3, the secondary standard is 60 ug/m^3.

NOTE: ug/m^3 = micrograms per cubic meter; ND = no data available.

SOURCE: California State Air Resources Board, Summaries of Air Quality Data 1981-1985.

TSP levels in the Mammoth Lakes area have regularly exceeded the old state 24-hour standard of 100 micrograms per cubic meter (ug/m^3) as well as the federal primary standard of 260 ug/m^3. The state annual average standard of 60 ug/m^3 and the federal secondary annual average standard of 75 ug/m^3 have also been exceeded frequently since 1981. Concentrations measured at the Mammoth Lakes Fire Station are higher than would be expected at the project site due to the station's proximity to the community of Mammoth Lakes and the rapid decrease in concentrations observed as one moves away from the community. Pollutant levels measured at Mammoth Lakes High School are thought to be representative of air quality levels at the project site (Cox, 1987).

PM_{10} monitoring has recently been initiated near Casa Diablo Hot Springs. Data from this study would be representative of levels at the project site, but these data are not currently available. PM_{10} data were collected at two sites in Mammoth Lakes during 1984 and 1985. These data are not representative of levels expected at the project site due to substantial contribution of fine particulates by the community of Mammoth Lakes. Twenty-four-hour PM_{10} levels at the Gateway and Fire Station sites in Mammoth Lakes were four times greater than the state 24-hour average standard of 50 ug/m^3. The annual average standard of 30 ug/m^3 was exceeded at these sites by about 50% during each year of the study. PM_{10} levels at the project site are expected to be lower than levels at Mammoth Lakes due to its distance from residential areas.

CO Sources and Levels. Carbon monoxide is created by combustion of fuels. Sources of CO in the project area include wood-burning stoves, fireplaces, and automobiles. CO monitoring by the GBUAPCD at two sites in the Mammoth Lakes area from 1981 to 1985 shows that CO standards have been exceeded once. Table 3-7 is a five-year summary of CO monitoring data in the area.

TABLE 3-7: CARBON MONOXIDE LEVELS IN THE MAMMOTH LAKES AREA, 1981-1985

Station	Averaging Period	Standard/a/	Carbon Monoxide Concentrations (ppm) 1981	1982	1983	1984	1985
Sierra PKRD	1-hour	20	13.0	18.0	14.0	ND	ND
	8-hour	9	6.4	11.1	7.9	ND	ND
Gateway	1-hour	20	ND	ND	ND	13.0	16.0
	8-hour	9	ND	ND	ND	7.3	7.4

/a/ State standards not to be equaled or exceeded. The 1-hour federal standard is 35 ppm, the 8-hour federal standard is 9 ppm. Underlined values exceed the standard.

NOTE: ppm = parts per million; ND = no data available.

SOURCE: California State Air Resources Board, Summaries of Air Quality Data 1981-1985.

O_3 Sources and Levels. O_3 is produced in the lower atmosphere through photochemical reactions involving hydrocarbons and nitrogen oxides. It is also formed where strong electrical fields (such as those associated with lightning or transmission lines) interact with air. The primary source of O_3 precursors in the project area is NO_x and VOC emissions from motor vehicles.

O_3 monitoring near Mammoth Lakes between 1981 and 1985 recorded one incidence of O_3 levels equal to the state standard of 0.10 ppm in 1985. Prior to that, the highest one-hour average for each year was reported to be 0.09 ppm.

H_2S Source and Levels. H_2S is a colorless, transparent, poisonous gas with a rotten-egg odor. Its danger to individuals depends on its concentration and the duration of exposure. The odor is detectable by humans at concentrations between one and 20 ppm. Concentrations between 50 and 500 ppm irritate the eyes and the upper respiratory track. At concentrations over 700 ppm, the gas can be lethal (Stellman and Daum, 1973).

Geothermal springs are the main source of H_2S in the project area. Although traces of H_2S gas are found in steam released by the springs, data obtained by the APCD from 1982 through 1984 showed generally low background concentrations of H_2S in the area. The state one-hour standard of 0.03 ppm for H_2S was equaled on three occasions between January 1982 and January 1985. The APCD currently limits H_2S emissions from geothermal wells to 2.5 kg/hr/well (5.5 lb/hr/well). According to the GBUAPCD, there have been no reported accidental releases of H_2S from the MP I geothermal plant and there have been no odor complaints or permit violations (Cox, 1987).

Isobutane Source and Levels. Isobutane is a colorless fluid which is shipped under pressure as a liquid. At atmospheric pressure and 15°C, it is a gas. The vapor is flammable at concentrations of 1.8 to 8.4% in air. At low concentrations it is odorless, but at higher concentrations it has a gasoline-like odor. It is used as the working fluid in the existing MP I power plant, where operating losses of 250 to 1000 lbs/day have occurred during 1987 (Walker, 1987). In 1974, there were 60,000 lbs/day of isobutane released in the State of California (Grosjean and Fung, 1984). Since 1974 isobutane has been introduced as a substitute for flourocarbons as a propellant for aersol sprays, so the state-wide emissions are likely to be much higher now. The emission rates published by the California Air Resources Board (ARB) lump isobutane with other volatile hydrocarbons, so the amount of isobutane is not readily available from published sources.

Isobutane can react photochemically to form air pollutants. On a scale from very reactive to non-reactive, isobutane is ranked as a moderately reactive compound (Atkinson, 1987; Maxwell, 1987; Allen, 1987). Reactive hydrocarbons can be ranked by comparing their rate constants (the rate at which a reaction between the hydrocarbon and other substances occurs). The ARB ranks reactive hydrocarbons according to a rate constant given in the units (1/ppm/min). The rate constant for isobutane in these units is 3,503. This level is moderately low relative to etylene at 12,600; propylene at 39,000; and ethyl butene at 200,000. The least reactive species listed by the ARB is ethane at 400.

The formation of ozone by isobutane is dependent on the presence of the OH radical which is found in low concentrations in rural areas (Allen, 1987). Because of the deficiency of OH, isobutane would react slowly to form ozone and would likely be dispersed before all the isobutane could react.

3.1.4.3 Regulatory Framework

Local air quality must meet both federal ambient air quality standards, established by the Environmental Protection Agency (EPA) pursuant to the Clean Air Act, and state standards established by the California Air Resources Board. The Great Basin Unified Air Pollution Control District (GBUAPCD) enforces these standards locally through its Rules and Regulations.

Mono County is currently "unclassified" for all criteria air pollutants. For regulatory purposes, "unclassified" areas are treated as attainment areas, meaning that standards for criteria pollutants are being met. According to the GBUAPCD, the designation for PM_{10} may change in early 1987, due to continued high particulate matter levels. It is likely that either the entire county or a portion of it, such as the Town of Mammoth Lakes, will be designated as "non-attainment" for PM_{10} (Cox, 1987). Such a change would require preparation of a PM_{10} attainment plan by the GBUAPCD. Such a plan would impose specific measures for reduction of PM_{10} levels.

The GBUAPCD has New Source Performance Standards for major sources to ensure that local air quality standards are maintained. Major new sources will be permitted by the APCD only after a demonstration that they will not cause local violations of air quality standards or degrade air quality in Class I air quality areas (such as the John Muir

Wilderness Area). The APCD has recently enacted a secondary source permit program for wood-burning devices, parking structures, and restaurants to control emissions of particulates.

Specific rules and regulations have been developed by the GBUAPCD to address the problem of H_2S emissions from geothermal sources. Particulate matter discharges from geothermal well drilling are controlled under Rule 404-A. Rule 424 specifies maximum sulfur and H_2S emission levels from geothermal plants, wells, and miscellaneous steam supplies.

3.1.4.4 Sensitive Peceptors

The project site is near three Class I Air Quality Areas: John Muir Wilderness, about 2.5 miles to the south; Ansel Adams Wilderness (formerly Minarets Wilderness), about 10 miles to the west; and Devil's Postpile National Monument, also about 10 miles to the west. The Clean Air Act Amendments of 1977 established a higher standard of protection for these pristine areas than for Class II Air Quality Areas such as the Mammoth Lakes Basin.

Other receptors that may be sensitive to high air pollutant concentrations include residents of the Town of Mammoth Lakes, about three miles to the west; Mono County employees, about 1.25 miles to the east; residents at Chance Ranch, about 1.5 miles to the east; residents at the Hot Creek Hatchery, about three miles to the east-southeast; and campgrounds at the Mammoth Visitor Center on the eastern edge of the Town of Mammoth Lakes.

3.2 BIOLOGICAL ENVIRONMENT

3.2.1 REGIONAL SETTING

3.2.1.1 Vegetation

The biological resources of the Mammoth Lakes region are strongly influenced by the region's topography and climate. The dominant topographic feature of the area is the

Sierra Nevada Mountain Range to the west. Comparatively flat, open terrain extends eastward. This area, between 7,000 and 8,000 feet in elevation, is in the rain shadow of the mountains and receives an average of approximately 10 inches of precipitation each year. Much greater amounts of precipitation fall at higher elevations nearby (Thomas, 1986a). Approximately 70% of the precipitation falls as snow during winter storms (USFS, 1980). Cold winters with below freezing temperatures and hot, dry summers are typical of the region. The climatic regime is the dominant influence on the plant communities, and consequently, the animal communities of the region. In the Mammoth Lakes region, the Sierra Crest is lower than areas to the north and south, so rainfall is higher and the area is more forested than the regions to the north and south which are sagebrush dominated (Taylor and Buckberg, 1987).

The region is on the boundary of two biogeographic provinces, the Great Basin and the Californian, and both mountain and desert plant communities occur there (Taylor and Buckberg, 1987). Nine major plant communities are found in the region. Five of these are forest types: red fir, white fir, Jeffrey pine, lodgepole pine and pinyon-juniper. Sagebrush scrub is the dominant brush community of the region. Meadows, marshes and riparian woods are the remaining major plant communities. Although they do not occupy large areas, these three communities provide diversity and are important habitats for many wildlife species (Taylor and Buckberg, 1987; USFS, 1980).

There are other minor plant communities unique to the region. They usually owe their existence to special circumstances such as pumice flats, geothermal vents or geothermally altered soils. The areas include thermal marshes and sand flats (USFS, 1980; Taylor and Buckberg, 1987).

3.2.1.2 Terrestrial Wildlife

The plant communities of the region provide habitats for a diversity of resident and migratory wildlife. Over 400 species of terrestrial vertebrates have been recorded in the Inyo National Forest. Some specialist species such as sage grouse, *Centrocercus urophasianus*, are restricted to single habitats, while generalist species such as coyotes, *Canis latrans*, range over almost all the habitats of the region.

Typical small mammals of the region include voles, Microtus sp., deer mice, Peromyscus maniculatus, and several species of chipmunks. White-tailed jackrabbits, Lepus townsendii, and Nuttal's cottontails, Sylvilagus nuttallii, are common (USFS, 1980; USFS, 1986; Ingles, 1965). Populations of these species fluctuate seasonally and year to year as weather changes affect food production and mortality (Ingles, 1965). Predators such as coyote; bobcat, Lynx rufus; badger, Taxidea taxus; mountain lion, Felis concolor; and black bear, Ursus americanus, are also found in the region. There are three migratory mule deer herds which use the Mammoth Lakes area: the Casa Diablo, the Sherwin Grade and the Buttermilk Herds (USFS, 1986).

There is a diverse resident avifauna in the area, which is complemented by winter migrants. There are approximately 40 breeding bird species in the area. Water fowl and shore birds comprise the bulk of the winter migrants and are mainly concentrated around Mono Lake and Lake Crowley (USFS, 1980).

Typical birds of forest habitats are Clark's nutcrackers, pygmy nuthatches, white-breasted nuthatches, and pine siskins. The drier sagebrush habitats contain sage grouse, sage thrashers and vesper sparrows (WESTEC, 1986). Ravens range throughout all the habitats of the Mammoth Lakes region. The important avian predators of the area are red-tailed hawks, Cooper's hawks, northern harriers, great horned owls and golden eagles. Bald eagles move through during fall migration, following the Owens River (McCarthy, 1987).

At least ten reptile and amphibian species have been recorded in the Long Valley caldera (USFS, 1980). These species have been little studied in the area. Thus, there is almost no published information on their distribution and habitat use. Rattlesnakes, Crotalus viridis; gopher snakes, Pituophis melanoleucus; and garter snakes, Thamnophis Celegans; along with western fence lizards, Sceloporus occidentalis; and whiptails, Cnemidophorus tigris, are expected to occur (WESTEC, 1986). In wetter habitats, common species such as Pacific treefrog, Hyla regilla, and western toad, Bufo boreas, should occur (WESTEC, 1986).

3.2.2 LOCAL TERRESTRIAL SETTING

A biotic assessment of the project area was performed in late 1986 by Dean W. Taylor and Richard Buckberg of Biosystems Analysis, Inc. Their report, published in early 1987, has been used for the information in this discussion of the local setting, except where another source is cited.

3.2.2.1 Vegetation

There are four plant communities on the proposed MP II & III project area; disturbed - ruderal, sagebrush scrub, Jeffrey pine forest, and Jeffrey pine/pinyon pine woodland.

- Disturbed - ruderal habitat occupies approximately 90% of the plant site, and is dominated by cheatgrass, dandelion, *Taraxacum officinale*, and peppergrass *Lepidium perfoliatum*. Due to the disturbed nature of the soil and the region's arid climate, this ruderal area is sparsely vegetated. It is crossed by several dirt roads, contains one geothermal well, and is used for equipment storage.

- Sagebrush scrub is widespread in the region in the more arid, lower elevations east of the base of the Sierras. The dominant species in these communities are sagebrush and bitterbrush with rabbitbrush, horsebush, *Tetradymia canescens*, and sulfer flower, *Eriogonum umbellatum*, also occurring (USFS, 1980). In some areas, this plant community is dominated by black sage, *Artemesia nova*, and forms a distinct community which is not common in the area.

  Sagebrush scrub is found in a narrow strip along the western edge of the site. Three proposed well sites are in this plant community. It is dominated by sagebrush, and in good rainfall years a lush understory of grasses and annual herbs is expected.

- Jeffrey pine forests are generally found between 7,000 and 10,000 feet (USFS, undated). These forests are dominated by Jeffrey pine, *Pinus jeffreyi*, in tall open stands. The forest contain an understory shrub layer which varies in density from open to thick. The understory contains a mix of species such as sagebrush *Artemesia tridentata*, bitterbrush, *Purshia tridentata*, manzanita, *Arctostaphylos patula*, and rabbitbrush, *Chrysothamnus nauseosus* (Holland, 1986; USFS, 1980). Snag density is low in the young forests in the project area.

Jeffrey pine forest occurs in a narrow band along the eastern edge of the site. Nine proposed well sites are in this plant community. This is the western edge of a larger forest located east of the site. The forest canopy cover varies from 30% to 60% and is dominated by Jeffrey pine. Sagebrush and bitterbrush are the major species in the shrub understory which varies greatly in density. There is very little grass cover.

- Jeffrey pine/pinyon pine woodland is a mid-successional plant community containing both pinyon pine, Pinus monophylla, and Jeffrey pine in the forest canopy. The understory flora is similar to that of Jeffrey pine forest. This woodland will eventually become Jeffrey pine forest in the absence of fire or other disturbance. One injection well (MP I 52A-32) is proposed in this habitat.

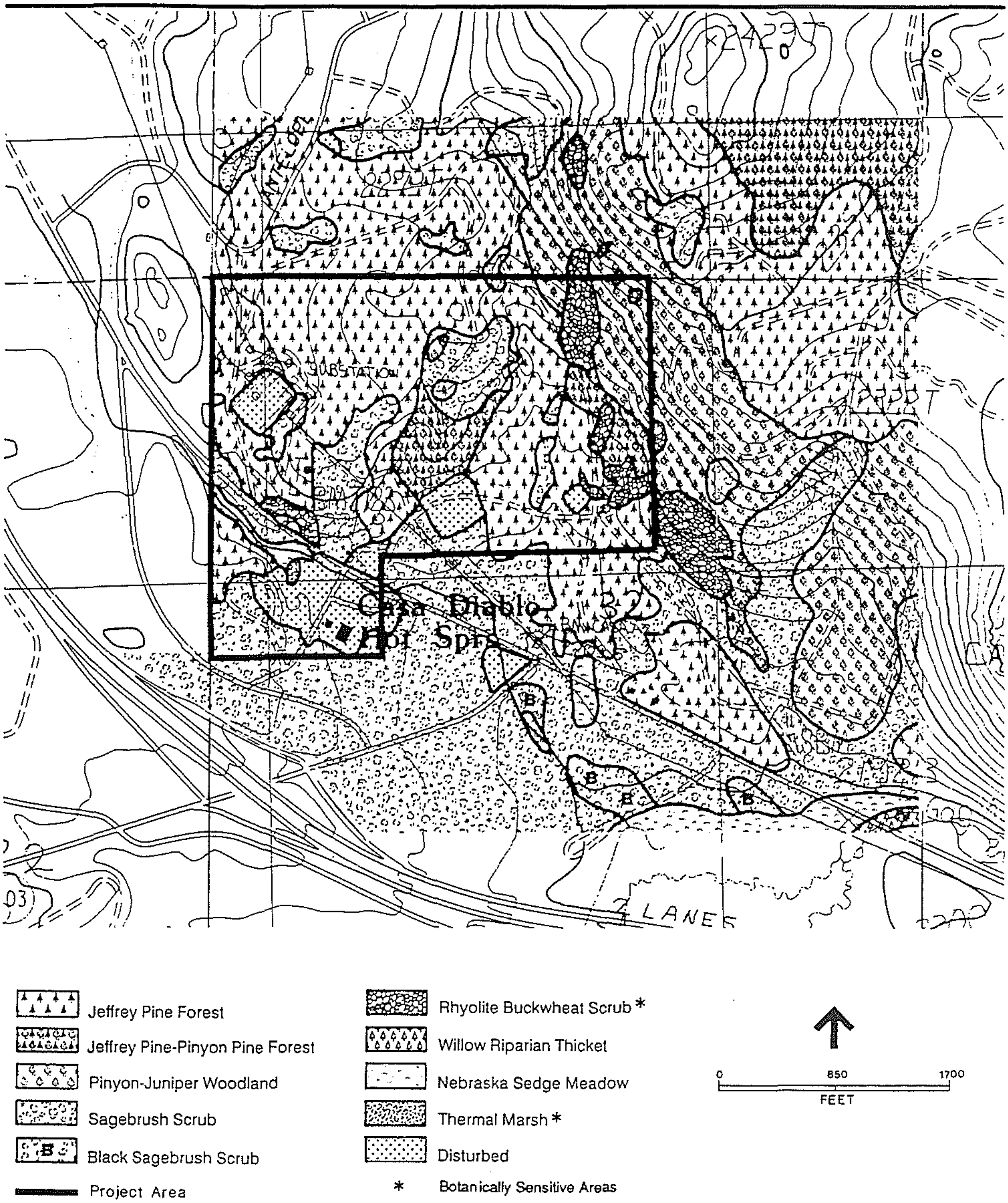
Two botanically sensitive habitats, thermal marsh and rhyolite buckwheat scrub occur within one-third mile of the MP II & III site (see Figure 3-5). Both are on private property and neither habitat occurs on the plant site. One injection well (MP I 52-32) may be in rhyolite buckwheat scrub, a botanically sensitive habitat.

No endangered, threatened, rare or other special status plant species are known to occur on site. Although botanical knowledge of the region is not complete, it is unlikely that any listed or special status plants occur on site.

Most of the plant site is disturbed. Native plant communities occupy less than one acre of land on the entire project site. Previous botanical surveys in the Casa Diablo Hot Springs area have not located rare plants on site. Sagebrush scrub is potential habitat for Mono milkvetch, Astragalus monoensis, and Howell's locoweed, Astragalus johannis howellii, both of which are state-listed rare plants. Mono milkvetch is known to occur approximately one mile north of the Mammoth Pacific site. Other rare plants of the Mammoth region are associated with habitats such as alkaline meadows or hot springs which do not occur on the project site (Taylor and Buckberg, 1986).

3.2.2.2 Wildlife

The MP II & III site is in a disturbed area with little plant cover and therefore little value for wildlife, but the site must be viewed in the context of the surrounding Jeffrey pine



SOURCE: Biosystems Analysis Inc., Jan. 1987

FIGURE: 3-5
Habitat Type Map

and sagebrush habitat. Activities on the site may affect animals in these habitats and many animal species are expected to cross the site in their daily and seasonal movements.

The Jeffrey pine forest is young and relatively open with few snags (standing dead trees) and little dead and down wood. This limits its value to cavity nesting birds such as pygmy nuthatches and hairy woodpeckers (Airola, 1980). These three species are forest service management indicator species. The shrub understory of sagebrush, bitterbrush and tobacco brush, provides food for species such as mule deer, white-tailed jackrabbit, western wood pewee, and song sparrow. American robins and mourning dove are expected to nest in the pines, and the cones provide seeds for chipmunks, scrub jays and Clark's nutcrackers.

The sagebrush scrub habitat is expected to be used by vesper sparrows, sage thrashers, green tailed towhees and brewer's sparrows. Typical rodents using this habitat are belding's ground squirrel, Citellus beldingii, merriams kangaroo rat Dipodomys merriami, and desert wood rat, Neotoma lepida (Ingles, 1965).

Predators in the area are expected to use both sagebrush scrub and Jeffrey pine forest. The most abundant of these is the coyote with badger, and bobcat common (Ingles, 1965; USFS, 1986). Rattlesnakes and gopher snakes are expected in the vicinity of the site during the warm spring and summer months (Stebbins, 1985; WESTEC, 1986).

3.2.3 SPECIAL INTEREST SPECIES

There are several wildlife species of special interest pertinent to the area. These are important due to their recreational value, special legal status, or their use by the USFS as indicator species for habitat quality.

Mule Deer. Mule deer are recreationally important in the Mammoth Lakes area, both consumptively and non-consumptively. Currently deer populations in the area are stable and healthy, after a period of decline in the 1950s and 1960s (Kucera, 1987a; Thomas, 1986a; Thomas, 1986b). The Sherwin Grade Deer Herd, the Buttermilk Deer Herd, and the Casa Diablo Deer Herd use the area around Mammoth Lakes, including the MP II & III sites. These herds are migratory, with the yearly cycle of movements tied to weather patterns and food resources. The breeding biology of the deer is adapted to their movements. The winter range, summer range, staging areas, and migration corridors are all vital links in the life histories of these herds.

The Sherwin Grade Herd winters in the area west of Highway 395, north of Pine Creek, generally south of Sherwin and Swall Meadows, and east of Wheeler Ridge (Kucera, 1987a). The plant community is sagebrush scrub, with sagebrush bitterbrush, and rabbitbrush as co-dominants. Bitterbrush is an important winter food and is supplemented by grasses and forbs in years with little snow cover. Winter deer counts yield estimates of 2,300 to 2,400 animals for the herd (Thomas, 1986a).

The Buttermilk Herd winters just south of the Sherwin Grade Herd and numbers approximately 2,000 animals. The plant communities in its winter range are similar to those of the Sherwin Grade Herd (Kucera, 1987b).

The Casa Diablo Herd numbers about 1,500 animals. They winter east of the Owens River, from Casa Diablo Mountain north and east to the California-Nevada border. Truman Meadow, Marble Creek, and a narrow strip of habitat between Black Rock Mine and Casa Diablo Mountain are the major wintering areas for this herd. The plant communities of these areas are similar to those of the Sherwin Grade and Buttermilk Herds winter range, with the addition of some pinyon pine habitat (Thomas, 1986b).

With the onset of spring, deer from both herds begin a leisurely migration west and up the Sierra slope. Generally this begins in mid-April. The routes, defined by the rugged topography of the Sierra, are traditional: young deer learn the routes from their parents and other members of the herd. Solitude Canyon, Mammoth Pass, and Duck Pass are the key migration routes over the mountains used to reach the summer range. To reach the passes, Sherwin deer move north from the wintering grounds, generally staying west of Highway 395 and east of the base of the Sierra. Some deer from the Sherwin Herd are thought to cross Highway 395 and use the habitats around Casa Diablo Hot Springs (McCarthy, 1987). A large staging area for deer migration lies southwest of the site, on the west side of Highway 395. This staging area is used by several thousand deer during spring migration. Deer from the Casa Diablo Herd are known to cross the proposed site as they migrate toward the Sierran summer range. About half of the 6,000 members of the three deer herds pass near the town of Mammoth Lakes, on their way to their summer ranges (Kucera, 1987b). A study of the migration in spring 1987 near Casa Diablo indicates that several dozen deer use the immediate vicinity of Casa Diablo during the spring migration (Kucera, 1987b). A copy of the report is in Appendix C.

The Buttermilk Herd winters south of the Sherwin. Grade Herd and numbers approximately 2,000 animals. The plant communities in their winter are similar to those of the Sherwin Grade Herd winter range (Kucera, 1987b).

Deer reach their summer range in approximately two months. The summer ranges of the two herds overlap and cover a much greater area than the winter range. The deer summer throughout the Ansel Adams Wilderness and over the crest to the west slope of the Sierra. Fawning occurs on the summer range (Thomas, 1986a).

The return migration in the fall is more rapid than the spring migration. It is triggered by the first storm which blankets food resources. This requires about two inches of snow at the 7,000-foot level. The fall 1986 to winter 1987 migration was atypical as no major storms arrived until January 1987. Thus deer moved downslope gradually over a period of several months. The same routes are used on fall migration as are taken on spring migration (Kucera, 1987a).

Sage Grouse. Sage grouse, Centrocercus urophasianus, are large upland game birds which are year round residents in the Mammoth Lakes region (McCarthy, 1987). They are USFS management indicator species for sagebrush plant communities (McCarthy and Hargis, 1984). Sage grouse inhabit, and are intimately tied to, sagebrush communities. Sagebrush stands provide nesting sites and thermal cover in spring and summer. During the winter, grouse consume sagebrush almost exclusively (Airola, 1980). Meadows and grasslands are heavily used during spring and summer, providing green forbs, seed, and insects. These food sources are particularly important in raising young.

Grouse use large open areas in the sagebrush for strutting grounds, known as "leks", during the breeding season. These leks are traditional sites in which grouse congregate and where the males perform courting displays (Call and Maser, 1985). After mating, females disperse to nest and raise the young. These leks are an important part of the habitat needs of this species. Major areas of sage grouse leks are in the Lake Crowley and Bodie areas. There are no leks in the immediate vicinity of the MP II & III site (McCarthy, 1987).

Sage grouse populations in the area severely declined about 10 years ago. In 1982, the sage grouse hunting season was closed and since that time, the local grouse population has approximately doubled. Now there are an estimated 1,000 grouse in the Lake Crowley/ Glass Mountain/Bald Mountain area.

Special Status Species. Several special status animal species with potential to occur on or around the project site are found in the Mammoth region. No special status species have been observed on project site.

- Bald eagles (Haliaeetus leucocuphalus) use the Owens River valley during winter migration (McCarthy, 1987). This species is listed as endangered (U.S. Fish and Wildlife Service, 1986). A single individual was observed by Taylor and Buckberg approximately one mile east of the site. There are no roosting or feeding sites on the study site or in the immediate vicinity.

- Peregrine falcons (Falco peregrinus) have been released at a site approximately 20 miles away as part of a reintroduction program for this endangered species (U.S. Fish and Wildlife Service, 1986). Peregrines could visit the site on hunting forays. There is no nest nesting habitat on or near the Mammoth Pacific site.

- Swainson's hawks (Buteo swainsoni) breed in riparian areas in the Great Basin. They have bred at Lake Crowley, approximately nine miles southeast of the project site (Airola, 1980). This is a federal candidate species, Category 2; that is, the U.S. Fish and Wildlife Service has some evidence for listing it as endangered, but conclusive evidence is not available (U.S. Fish and Wildlife Service, 1986). Swainson's hawks may use the site vicinity for foraging, but there is no nesting habitat on or near the site.

- Ferruginous hawks (Buteo regalis) are winter visitors in the Mammoth area, using grasslands for foraging (Airola, 1980). This species, like the Swainson's hawk, is a federal candidate, Category 2 (U.S. Fish and Wildlife Service, 1985). They are not expected to use the habitats on site.

- Golden eagles (Aquila chrysaetoes), year long residents in the region, are protected by the federal Bald Eagle Act. There are known nest sites near Bridgeport and Benton (Airola 1980). Golden eagles probably occasionally use the project vicinity for foraging.

- Owens Valley vole (Microtus californicus vallicola) is listed as a federal candidate species, Category 2 (U.S. Fish and Wildlife Service, 1985). They are known to occur in the Owens Valley in southern Mono County, though little is known of their precise distribution. Voles are primarily inhabitants of grasslands, meadows and riparian areas (Ariola, 1980). They are not expected to occur on-site.

- Owens River Tui chub (Gila bicolor snyderi) is a federally listed endangered species which is found in the springs near the headwaters of Hot Creek. The U.S. Fish and Wildlife Service will issue a biological opinion on the Owens River Tui chub pursuant to Section 7 of the Endangered Species Act.

3.2.4 AQUATIC ENVIRONMENT

The major waters near the project area consist of hot springs, artesian springs and surface waters. No perennial streams are found on the project area itself, but there is an ephemeral stream draining the site. The area is within the watershed of Mammoth Creek, a perennial stream fed by rainfall, snowmelt and springs. Surface water temperatures range from 10° to 14°C (WESTEC, 1986). Water quality may be influenced by construction and waste inputs from human activity near the city of Mammoth Lakes and nutrient in the puts by grazing livestock along its streambanks. Three hot springs (AB, CD, H1; see Figure 3-3) form the headwaters of Hot Creek and average 11° to 16°C in temperature (WESTEC, 1986). Hot Creek Hatchery, managed by California Department of Fish and Game (CDFG), is situated in this area and takes advantage of this water source in its hatchery operations. A fourth hot spring (H2,3) enters into Hot Creek below the hatchery facility; downstream from this point Mammoth Creek joins with Hot Creek. The creek, as it flows east and north towards the Owens River, gradually increases in temperature as inflow from hot springs within the stream channel and along its banks augments the stream flow and raises its temperature.

Both Mammoth and Hot Creeks support naturally spawning populations of rainbow and brown trout. The only stocking activity carried out by CDFG in the project area takes place in Mammoth Creek upstream of Highway 395. Fishing activity is great in both creeks; however, Hot Creek is one of only two state-classified wild trout fisheries in the Inyo National Forest (USFS, 1986) and is one of the few trophy trout streams in

California. The brown trout in Hot Creek exhibit exceptional growth due to the geothermal enhancement of the stream water. The elevated temperatures increase primary and secondary productivity, in the form of aquatic plants and numerous insects, as well as raising the metabolic rates of resident trout. Below the confluence of Mammoth Creek and Hot Creek, fishing regulations are such that only artificial dry flies on barbless hooks may be used and any fish caught must be released unharmed. These restrictions are strictly enforced and apply upstream through the Hot Creek Ranch property, a private, commercially operated fishing facility, and downstream to the Owens River.

The hot springs also provide a unique habitat for the endangered Owens River Tui chub (Gila bicolor snyderi). The distribution of this sub-species of Tui chub has been gradually restricted by the development of dams and subsequent water withdrawals within the Owens River watershed. It now exists in scattered refugia in the drainage area, with the hot springs around the fish hatchery included as one of these refugia. To date a recovery plan for this fish has not been written; however, U.S. Fish and Wildlife Service will issue a biological opinion based on a Section 7 consultation in progess.

The Hot Creek Hatchery is one of four major fish hatchery facilities in the state and is one of the oldest. It was brought into operation in the 1930's and operations include production of trout eggs for other state hatcheries; rearing of fingerlings and catchable trout to be stocked in Sierran streams, lakes, and reservoirs; and production of brood stock for future egg production. Approximately 22 million eggs are produced per year from this hatchery, about 1.25 million fingerlings are taken to other CDFG regions for stocking and at least 700,000 catchable trout (nine to 10 inches) are stocked in Alpine and Mono county waters (Eichmann, 1987a).

There are a total of seven strains of both domestic and wild trout that are raised at the hatchery. Early spawning in some of the brood stock strains has been genetically selected for, in a practice that has continued for at least the past thirty years. These trout, under natural conditions, would spawn in the fall; however, over time these selected strains have been induced to spawn in the summer months. This method allows for more rapid growth so that the young can be used in the following spring for stocking purposes.

3.3 SOCIAL ENVIRONMENT

3.3.1 VISUAL RESOURCES

3.3.1.1 Existing Programs, Plans, and Policies for Managing Visual Resources

3.3.1.1.1 County Plans and Policies

The Scenic Highways Element to the Mono County General Plan designates State Route 203 and Highway 395 as scenic highways. This scenic designation is intended to protect and enhance the visual environment in areas of particular scenic value. In order to promote uniform environmental review of projects in the area, the Mono County Office of Energy Management intends to use the framework established by the USFS to evaluate visual impacts as well as requiring site specific mitigation through the conditions of the CUP. A description of the USFS Visual Mangement System (VMS) is described below.

3.3.1.1.2 Bureau of Land Management (BLM) Policies

GRO Order 4 (U.S. Geological Survey, Conservation Division, 1976) requires lessees of geothermal resource areas under federal jurisdiction to reduce the visual impact of geothermal development through careful site selection and through sensitive design and construction of facilities.

3.3.1.1.3 Forest Service Plans and Policies

The USFS's Environmental Concern Maps for the Geothermal Lease Area, Inyo National Forest (USFS, 1980), designate the proposed project site, and most adjacent areas along Highway 395, as Visual Resource Constraint Level 2, where surface occupancy should be limited to controlled off-road vehicle use, and surface occupancy for geothermal activities should be excluded "unless surface management concerns can be mitigated."

Furthermore, the Draft Land and Resource Management Plan, Inyo National Forest (USFS, 1986b) designates the project area for "Retention." Management policy for Retention areas is to allow only activities and facilities that are not evident to the casual visitor. The Management Area Directions for visual resources include "working toward mitigation of existing major detracting uses" in the "seen area" from Highway 395. The visual

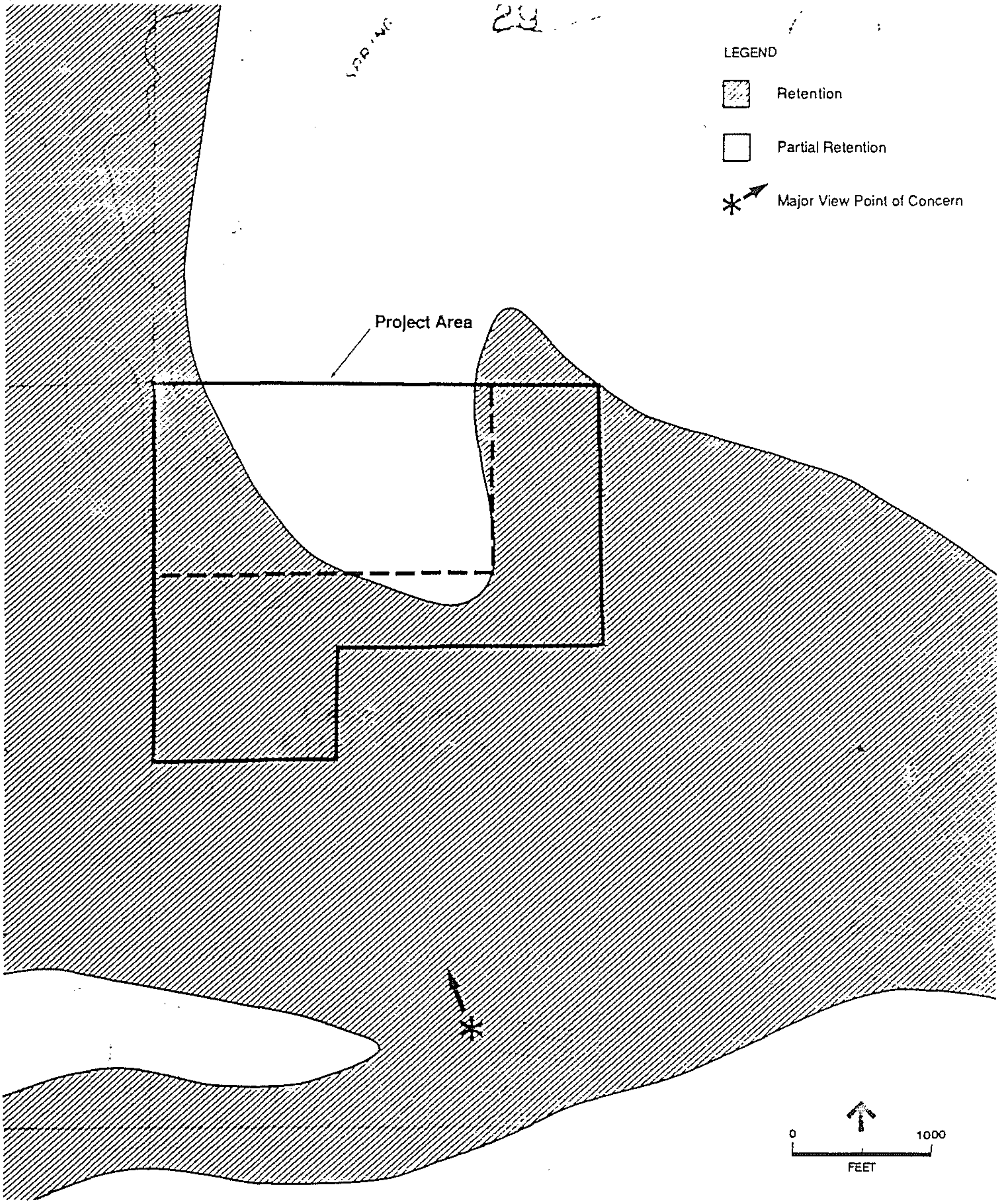


FIGURE: 3-6
Visual Quality Objectives and
Major Viewpoint near Casa Diablo

SOURCE: U. S. Forest Service, 1987.

		Sensitivity Level						
		fg1	mg1	bg1	fg2	mg2	bg2	3
Variety Class	class A	R	R	R	PR	PR	PR	PR
	class B	R	PR	PR	PR	M	M	M / MM
	class C	PR	PR	M	M	M	MM	MM

Symbol Objective

R	Retention	M	Modification
PR	Partial Retention	MM	Maximum Modification

SOURCE: USFS, 1974

FIGURE: 3-7

USFS Visual Management System

resource policies in the Management Plan were developed using the USFS's Visual Management System (VMS), a system developed as part of its National Forest Landscape Management program (USFS, 1974). The VMS applies to all management activities on National Forest lands. The management objectives for the Casa Diablo vicinity are shown in Figure 3-6.

<u>USFS Visual Management System</u>. The intent of the VMS is to identify the visual character of the landscape, catalog its visual quality, and analyze in advance the visual effects of resource management actions. The VMS methodology consists of: identifying the Character Type and inventorying variety classes of the landscape and its subdivisions; preparing a Sensitivity Level inventory that addresses both visibility and volume of viewers; and using the Variety Class and Sensitivity Level inventories to identify Visual Quality Objectives -- acceptable degrees of alteration of the natural landscape.

Variety Classes include A (distinctive), B (common), and C (minimal). Sensitivity Levels are determined through a combination of Distance Zones (foreground, middle ground and background) and Sensitivity (rated on a scale of 1 to 3 based on the number and interests of users). Visual Quality Objectives include Preservation, Retention, and Modification. Figure 3-7 illustrates the relationship between Variety Class, Sensitivity Level, and Visual Quality Objectives.

3.3.1.2 Sensitive Receptors

All people exposed to the landscape proposed for modification are considered to be sensitive receptors. Expectations and aesthetic concern varies with the viewer, so that the response of a particular viewer is highly subjective. In general, the USFS considers recreationists to be the major viewing population, but for purposes of analyzing visual impacts in the project area, the USFS does not distinguish between first-time viewers and repeat viewers or resident and non-resident viewers (Rickford, 1987).

3.3.1.3 Regional Setting

The visual character of the region in which the project site is set is dramatic and is one of the primary attractions for visitors to the Mammoth Lakes area. The project site lies on the edge of Long Valley on the eastern side of the Sierra Nevada. The snow-capped peaks of the Sierra Nevada, several of them over 14,000 feet in elevation, rise abruptly to the west from a base elevation of about 7,500 feet. The rugged topography and the young geology of the region provide several visual resources of particular scenic value, including Mammoth Mountain, Mammoth Rock, Crystal Crag, Devil's Postpile, and Long Valley. Long Valley is a large, sparsely vegetated basin that drops away from Highway 395 to the east, affording sweeping vistas. Devil's Postpile National Monument, Minarets Wilderness, and John Muir Wilderness are local natural areas of high-quality visual resources preserved for the enjoyment of the general public.

The vegetation and wildlife of the region contribute to its high visual quality. Overall, the variety of vegetation and topographic features is high. Patches of pine forest and meadow, barren rock outcrops and avalanche slopes, chapparal and sagebrush add texture and color. Low ridges and isolated hills break the view and create contained views of distinctive landscapes. Wildlife is abundant in the area and views of deer, hawks, eagles, rabbits, and other animals greatly enhance the aesthetic experience both for those pursuing recreational activities in the more isolated portions of the region, and for residents and visitors traveling local roads and highways. The water of streams, lakes, seeps, and snow is an attractive visual element common in landscapes visible from regional public viewpoints.

3.3.1.4 Project Area

The project site is a gently sloping area of primarily sagebrush scrub and scattered pine trees on the northeastern side of Highway 395 near the terminus of State Route 203. Hot Springs Road provides access to geothermal development areas near the project. The existing geothermal development, MP I, lies southwest of the project site. A network of existing roads to the MP I well fields covers most of the project area.

The project site lies about 1,600 feet northeast of Highway 395 and about 600 feet northwest of State Route 203, at their nearest approaches. The project site is open to view by motorists traveling northeast on State Route 203 east of Highway 395. Traffic volumes on State Route 203 are small and, thus, public exposure of the site from this public viewpoint is minor. The general project area is visible from portions of State Route 203 west of Highway 395 and also from portions of Sawmill Road, but the power plant site itself cannot be distinguished from adjacent areas at these distances. The power plant site is also open to view from Highway 395, from about 5,000 feet southeast of its junction with State Route 203 to about 4,600 feet northwest of that junction. The clearest views of the proposed power plant site along Highway 395 are for the northbound travel lanes, from about 4,600 feet to about 2,000 feet southeast of its junction with State Route 203. A long, low forested ridge to the north of the project site provides a backdrop, as viewed from Highway 395, that serves to minimize the visibility of individual features of the site and of the existing MP I geothermal development northwest of the site.

Highway 395 itself, local roads, the County buildings and impound yard, the Mammoth-June Lakes Airport, the Town of Mammoth Lakes, electricity transmission lines, fences, the existing geothermal development, and gas and propane storage tanks -- with their regular outlines, even texture, and colors atypical of the natural environment -- can be seen from the major viewpoint located south of the project area on Highway 395. Mining activities and roads providing access to mining claims and recreational areas also contrast with the generally natural landscape. In the daytime, sunlight reflects from metal and glass surfaces; at night, lights from structures and from cars on Highway 395 can be seen within the generally uninterrupted darkness typical of the natural areas along Highway 395. Night lighting from the existing geothermal plant at Casa Diablo may attract the attention of motorists on Highway 395, State Route 203, and Sawmill Road.

3.3.2 SOCIOECONOMICS

3.3.2.1 General Socioeconomic Characteristics

The population of the Mammoth Lakes region has dramatically increased during the last two decades. The population grew from 2,213 in 1960 to 4,016 by 1970 and more than doubled to 8,577 by 1980. The rate of growth has slowed significantly in recent years and is estimated to have reached 9,200 by July 1, 1986 (California State Department of Finance, Population Research Unit, 1987). Most of the population of Mono County resides in the recently incorporated Town of Mammoth Lakes, which has a year-round population of approximately 5,000. Peak population on winter weekends reaches 35,000. Employment is concentrated in the government, retail sales and service sectors, with service employment mostly generated by tourism (Hawley, 1987). No residents live on or immediately adjacent to the project site.

3.3.2.2 Land Use and Planning

The proposed sites for the MP II & III geothermal plants and the well fields for MP II are located on a private geothermal lease (Assessor's Parcels No. 37-050-02 and -05) in the vicinity of the Casa Diablo Hot Springs. This lease is located in unincorporated Mono County, approximately three miles east of the Town of Mammoth Lakes. When the application for the Conditional Use Permit (CUP) was filed with the County, the property was zoned General Purpose (GP) by the Mono County Zoning Ordinance and classified as Mixed Intensity Multiple (MM) by the Mono County General Plan. The MM designation allows a variety of uses.

The site for well fields for MP III, located within the Inyo National Forest, is under the jurisdiction of the BLM, which manages all geothermal resources on USFS land. The lease (CA 11667A) is contained in Lease Block I, a parcel of 27,450 acres currently under geothermal lease status. Adjacent to the site are approximately 2,560 acres owned by LADWP, most of which is used for grazing livestock. The project is within the Long Canyon Unit of the Hot Creek Grazing Allotment, administered by Inyo National Forest, and at the southern edge of an area managed for commercial timber production. Two 115 KV transmission lines run from the SCE Casa Diablo substation, about one-quarter mile north of the site, and continue south toward Bishop. Major land uses in the project vicinity are shown in Figure 3-8.

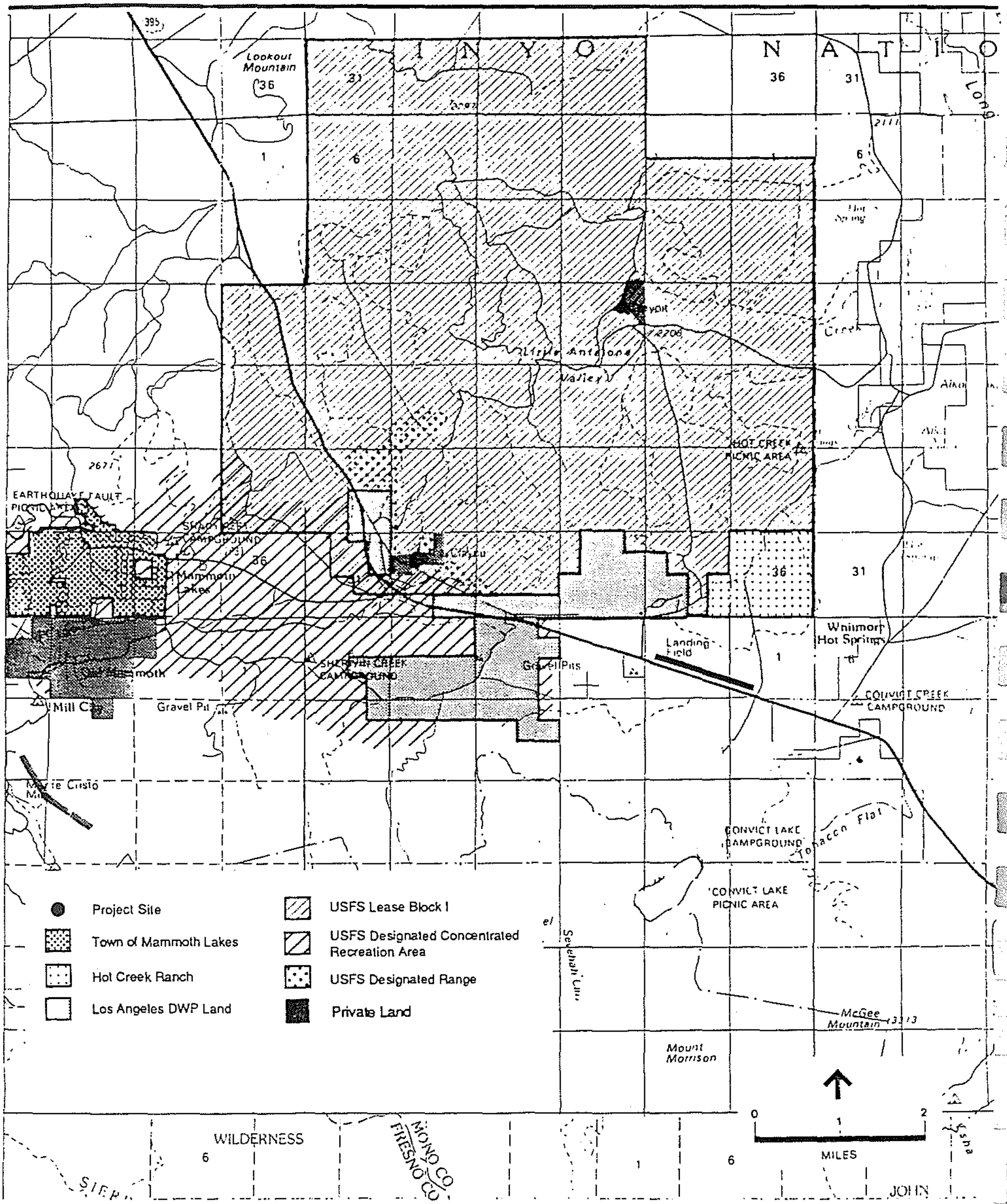


FIGURE: 3-8
Land Management Areas and Land Use

SOURCE: Bureau of Land Management, Surface Management Status Map, 1976, and ESA, Inc.

Land uses within the vicinity of the project site include the following:

- MP I power plant, immediately adjacent to the site;
- Casa Diablo Substation, operated by Southern California Edison Company, about one quarter mile north of the site;
- Mono County Buildings and impoundment yard, one and a quarter miles southeast of the site;
- A liquid propane storage facility, one and a quarter mile southeast of the site;
- Chance Ranch, a private ranch, approximately 1.5 miles east of the site;
- Sherwin Creek Campground, one and one half miles southwest of the site;
- Mammoth-June Lake Airport, three to four miles southeast of the site;
- USFS Gravel/Borrow Pits at the north side of the airport;
- Sierra Quarry, operated by Honeywell, at the south side of the airport;
- Hot Creek Fish Hatchery, operated by the California Department of Fish and Game, three miles east of the site;
- Old Mammoth School, southwest of Hot Creek Fish Hatchery;
- Hot Creek Ranch, a private trout fishing resort, four miles east of the site; and
- Shady Rest Campground, three miles west of the site.

The two major highways used for access to the MP II & III site are designated as official scenic highways. Highway 395, from post mile 18.0 near the southern edge of Long Valley to post mile 26.9, 1.1 miles north of State Route 203, is an official state scenic highway. Highway 395 from the Tioga Turnoff to the Inyo County Line, and State Route 203 from the Highway 395 junction to the Sierra Park Road junction are official county scenic highways. As required under state law the Mono County Planning Department has developed a program for protecting and enhancing these scenic corridors (California Department of Transportation, 1982). The adopted Mono County Scenic Highway Element requires that utilities be located and designed in a manner which minimizes visual impacts. The Element also requires that visually offensive land uses be adequately landscaped and screened (Mono County, 1981b).

3.3.2.3 Economics

Mono County's economy is primarily based on recreation. Retail revenues are highly seasonal, peaking during the winter skiing season, with a secondary peak during July and August. As illustrated in Table 3-8, sales revenues normally peak in the first and fourth quarters of the year then decrease sharply. Employment also peaks in the first and fourth quarters but has been falling since early 1985 (see Table 3-9). Events and activities that negatively affect the numbers of skiers (e.g., earthquake activity or little snowfall) dramatically affect the region's economy. The economic and employment imbalance between the winter ski season and off-season periods is a concern to the community. Summer and spring recreational activities are being promoted to achieve a more balanced tourism industry (Hawley, 1987).

TABLE 3-8: TAXABLE SALES - MONO COUNTY

Time Period	Sales Revenues
1st Quarter, 1982	$23,133,000
2nd Quarter	16,847,000
3rd Quarter	20,916,000
4th Quarter	22,742,000
1st Quarter, 1983	$24,345,000
2nd Quarter	15,260,000
3rd Quarter	20,891,000
4th Quarter	20,467,000
1st Quarter, 1984	$22,226,000
2nd Quarter	16,709,000
3rd Quarter	22,529,000
4th Quarter	21,642,000
1st Quarter, 1985	$22,487,000
2nd Quarter	17,084,000
3rd Quarter	22,736,000
4th Quarter	21,991,000
1st Quarter, 1986	$28,752,000
2nd Quarter	17,825,000

SOURCE: California State Board of Equalization, Taxable Sales in California, First Quarter 1982–Second Quarter 1986.

TABLE 3-9: EMPLOYMENT IN MONO COUNTY

Time Period	Persons Employed
1st Quarter, 1983	4,658
2nd Quarter	4,575
3rd Quarter	4,817
4th Quarter	4,808
1st Quarter, 1984	4,708
2nd Quarter	4,512
3rd Quarter	4,558
4th Quarter	4,675
1st Quarter, 1985	5,100
2nd Quarter	4,550
3rd Quarter	4,542
4th Quarter	4,583
1st Quarter, 1986	4,467
2nd Quarter	4,233
3rd Quarter	4,100

SOURCE: California State Employment Development Department, California Labor Market Bulletin, January 1983–October 1986.

The unbalanced nature of the local economy due to its heavy reliance on recreation activities is revealed in the 1983 survey of the Mammoth Lake labor force summarized in Table 3-10. The survey found no employment in the agricultural, mining, or manufacturing sectors; however, 37% of the labor force was employed in the recreational and service sectors. A large construction sector, 3.5 to four times California's state-wide average, was also present (Earth Metrics, 1984). The operating geothermal plant, MP I, provides 16 full-time jobs, approximately 0.2% of the local labor force. Eleven of these jobs filled by residents of Mono County (Asper, 1987b).

The California Department of Fish and Game's Hot Creek Hatchery is important to the economics of the State's trout program. One of only three rainbow trout brood stock hatcheries in California, Creek Hatchery provides approximately 20 million fish eggs for use in the State's year-round trout program and for use by hatchery systems of several

TABLE 3-10: DISTRIBUTION OF MAMMOTH LAKES' LABOR FORCE BY EMPLOYMENT SECTOR, 1983 SURVEY

Sector	Percent of All Employees
Agriculture, Forest, Fish	0
Mining, Manufacturing	0
Construction	14
Transportation, Utilities	3
Restaurant, Bar	10
Wholesale, Retail Trade	16
Finance, Insurance, Real Estate	6
Recreation	25
Services	12
Government	6.5
Lodging, Property Management	10
Total Number of Employees	5,559

SOURCE: Earth Metrics, Inc. 1984. Mammoth Lake Housing Study Needs.

other western states. Hot Creek Hatchery is also responsible for the production and planting of 700,000 catchable trout annually in the Inyo-Mono area and handles the major part of backcountry aerial planting in the northern Sierra Nevada. A unique fall spawning strain of rainbow trout, developed at the Hot Creek Hatchery, and the constant, high temperature of the rearing ponds, provides fish of a plantable size up to six months earlier than typical rainbow trout. This gives California the capability to plant trout all year long. The California Department of Fish and Game suggested a method to quantify the "dollar value" of the recreational days provided by fish and eggs from Hot Creek Hatchery in 1976. The method involves estimating the number of recreational and angler days supported through visitor use and fish/egg production at Hot Creek Hatchery and multiplying these amounts by the estimated value (i.e., associated consumer expenditures) of a recreational day and an angler day, respectively. The following values were estimated:

Direct Angler Days		$6,545,000
Indirect Angler Days		2,873,000
Direct General Recreation		48,562
	TOTAL	$9,466,562

In determining the value of direct angler days, the Department of Fish and Game estimated that 770,000 of the 2,650,000 fishes produced annually at the hatchery would be caught by anglers. Based upon the assumptions that the average angler catches two fishers per day and that the value of an angler day is $17.00, the fish produced at the hatchery would support 385,000 angler days, worth $6,545,000. The value of indirect angler days was based on a fraction, ten percent, or the value of angler days supported through fish egg production. The Department of Fish and Game estimated that the 10 million fish eggs shipped from the hatchery will result in approximately 3,380,000 fishes caught by anglers. These were estimated to produce 1,690,000 angler days valued at $28,730,000. Applying 10% as the contribution attributable to the egg production, the indirect angler days supported by egg production at the hatchery was valued at $2,873,000. Finally, the direct general recreational value of the hatchery was based on an estimate of visitation to the hatchery amounting to 24,281 general use days. Assuming the value of a general recreational day to be $2.00, the hatchery itself yeilded a direct general recreational value of $48,562. These values are all based on 1976 dollars (Fullerton, 1976). Adjusted for inflation, a simular "dollar value" today would equal over $19,000,000 annually.

3.3.2.4 County Fiscal Considerations

Mono County receives revenues from a variety of sources. Total revenues for fiscal year 1985-86 were $13,517,524. Approximately 41.6% came from state, federal and other government sources. The remaining 58.4% was from local sources, with taxes accounting for 43.2% of total revenues. Charges for county services, licenses and permits accounted for 11%. Income from the use of money and property amounted to about 1.9%. The remaining 2.3% came from miscellaneous sources. The actual dollar amounts of revenues from each of the above sources are summarized in Table 3-11. Geothermal activities accounted for about 6.3% of the revenues. Through possessory interest the county benefits from the ad valorem (property) tax revenues paid on the value of geothermal facilities even when the facilities are located on federal land. When the geothermal lease occurs on federal lands, the state receives 50% of the federal lease royalties and rentals and redistributes 20% of the original amount to the county. In addition, geothermal activity at the existing MP I plant supported purchases from merchants in Mono and Inyo Counties totaling $159,000 in 1986 and a direct payroll of $451,173 in 1986 which indirectly increased sales tax revenues (Asper, 1987b).

TABLE 3-11: GENERAL REVENUES FOR MONO COUNTY (Fiscal Budget 1985-1986)

Source	Value
Total Taxes	$5,836,321
Licenses and Permits	146,838
Fines, Forfeitures and Penalties	194,385
Use of Money and Property	252,781
Aid from Other Governmental Agencies	5,625,084
Charges for Current Services	1,343,740
Other Collected Revenues	118,375
GRAND TOTAL REVENUE	$13,517,524
(Geothermal Revenues)	($793,883)

SOURCE: Mono County Final Budget, 1986-1987.

The county expenditures for fiscal year 1985-86 equaled $13,517,524. The largest category of expenditures (30.7%) provided for the general function of the county (i.e., legislative and administrative services, finance services, elections, property management, insurance, and other miscellaneous general services). The next largest categories of expenditures were public protections (22.7%), public ways and facilities (21.1%), and health and sanitation (12.2%). The remainder (13.3%) was spent on public assistance, education and recreation, and reserved for operating contingencies. The dollar amounts for the County of Mono 1985-86 budget are presented in Table 3-12. Geothermal lease and royalty revenues from federal lands to the county are channeled into the Geothermal Lease Fund. These monies are used to fund 40% of the County's Energy Management Department and for community improvement purposes largely related to geothermal and recreational facilities. The Fund's balance as of December 31, 1986 was $903,000 (Lyster, 1987).

TABLE 3-12: APPROVED EXPENDITURES FOR MONO COUNTY
(Fiscal Budget 1985-1986)

Category	Amount
General Functions	$4,154,649
Public Protection	3,064,873
Public Ways and Facilities	2,853,109
Health and Sanitation	1,654,854
Public Assistance	823,932
Education and Recreation	296,922
Contingencies	669,185
GRAND TOTAL	$13,517,524

SOURCE: Mono County Final Budget, 1986-1987.

3.3.2.5 Community Services

3.3.2.5.1 Schools

The Mammoth School District provides local elementary and secondary education for the area. The former Mammoth Elementary School, condemned due to earthquake damage, is located near the Hot Creek Fish Hatchery, east of Highway 395, and is not currently in service. The new elementary school located adjacent to the Mammoth High School, is scheduled to open in February 1987. However, it is not large enough to handle the current elementary school enrollment and six portable classrooms will remain in operation. The district is currently planning to build another wing on the elementary school to relieve the overcrowded conditions. Both elementary and secondary students (as of January 31, 1987) attend classes at Mammoth High School. Many of the classes are conducted in temporary facilities.

The 16 full-time employees of the MP I geothermal plant have five children attending Mammoth School District and five children attending school in Inyo County (Asper, 1987b).

In addition to the problem of overcrowding, the district is also affected by the influx of "transient" students during the winter season. The enrollment level as of January 1987, was 368 elementary students and 293 secondary students. Enrollment drops off just after Easter when the skiing season ends and seasonal employees move their families away. The 1987 faculty consists of 14 full-time elementary teachers, one part-time elementary teacher, 16 full-time high school teachers, two part-time high school teachers, and one district teacher. Staffing is not affected by the seasonal variation in enrollment (Martin, 1987).

3.3.2.5.2 Police

Law enforcement is provided by the Mono County Sheriff's Department headquartered in Bridgeport. There are a total of 37 personnel in the department, 24 sworn officers and 13 public safety officers. The closest officers to the site are four resident deputies located at Crowley Lake providing coverage on an on-call basis. Priority response time to the site is estimated at five to 10 minutes (15 minutes in the early morning if no one is on duty). Non-priority response is on an "as available" basis. The substation that previously serviced the site, located at Old Highway 395 and Sherwin Creek Road, was abandoned in July-August 1986. The California Highway Patrol has primary responsibility for traffic control and accident investigation for State Route 203 and county roads. The Sheriff's Department maintains mutual aid agreements with all surrounding law enforcement agencies (i.e., USFS, Highway Patrol, Mammoth Lakes Police, and Department of Fish and Game). These agencies are called upon only in emergency situations as back-up to the Sheriff's Department. All arraignments and hearings are held in the Bridgeport courthouse, requiring officers to travel there for testimony and prisoner transfer. No incidents have been reported as of January 26, 1987, at the adjacent MP I geothermal plant (Padilla, 1987).

3.3.2.5.3 Medical Facilities

The closest medical facility is the Centinela Mammoth Hospital located in the town of Mammoth Lakes on Sierra Park Road. The Centinela Mammoth Hospital is accredited by the Joint Committee on Hospitals and provides in-patient, out-patient, and 24-hour emergency medical care. The hospital maintains 15 acute care beds (two in the intensive care unit, 13 for general services), the structure and equipment for emergency room services, a complete diagnostic materials center, and a local clinic which provides staffing. The staffing level varies with the season, peaking with 75 personnel in the winter and lowering to 50 in the summer. Ten year-round physicians are on the staff. On a year-round basis, the hospital only operates at 30% of capacity. However, the hospital often operates at near-peak capacity during winter weekends. The second and third nearest hospitals are Mono General Hospital in Bridgeport and Northern Inyo Hospital in Bishop. Ambulance service is provided by the Mono County Paramedics for which the Centinela Mammoth Hospital serves as a base station. Additional ambulance service is provided by the Centinela Mammoth Hospital, Ground-Aegis Ambulance Service and the Bishop Sierra Ambulance Service, the latter two located in Bishop. Emergency transportation services are provided for by Care Flight, based at Washoe Medical Center in Reno, Nevada. Burn victims who require treatment beyond local capabilities may be transported to burn centers in Las Vegas, Nevada, or Sherwin Oaks, California (Jacobsen, 1987).

3.3.2.5.4 Fire Protection

Local fire protection is provided by the Long Valley Fire Protection District. The district operates three triple combination pumper engines (two capable of delivering 1,000 gallons per minute and the third capable of 750 gallons per minute) and one automobile out of the Hilton Creek Station located about five miles from the site. Staffing consists of 12 volunteer firefighters and one full-time Chief of Staff. Emergency response time to Casa Diablo, when a crew is available, is estimated at 12 to 15 minutes. Due to its proximity, the Mammoth Lakes Fire District, located on State Route 203 near the intersection of Pine Crest, responds to calls in the vicinity. The response time from Mammoth Lakes is approximately seven minutes. The Mammoth Lakes fire station is staffed by a full-time Chief, Assistant Chief and 50 volunteer firefighters. The surrounding Inyo National Forest lands are protected by the USFS, which rates the area as a "high fire hazard." Mutual aid agreements are in effect for all surrounding jurisdictions and an automatic aid agreement with the Mammoth Lakes Fire Department. The principal fire concerns in the Casa Diablo area are the use of isobutane at the MP I geothermal plant, the distance from the fire stations, and the poor water supply. In the event of a fire at Casa Diablo, nearby areas of concern are the traffic on adjacent Highway 395; the three 10,000 gallon gasoline storage tanks owned by Chevron, located one-quarter mile southeast of State Route 203 and one-eighth mile north of Highway 395; and the 100,000 to 150,000 gallons of propane stored in six tanks owned by Cal-Gas, Petro-Lane, and Turner, located approximately one mile east of the site. Fire safety requirements governing construction are contained in the 1976 and 1982 Uniform Fire Codes, with amendments, and special fire protection district provisions (Malby, 1987).

3.3.2.5.5 Street and Road Maintenance

Street and road maintenance is provided by the County for all non-state and non-federal county roadways. This responsibility includes road repair, maintenance, and snow removal. Snow removal requires up to two-thirds of the total maintenance and improvement budget (WESTEC, 1986). Private roads are maintained by owners.

3.3.2.5.6 Wastewater

The Mono County Water District operates a community sewage system and sewage treatment facility for residents of the Mammoth Lakes and Lakes Basin areas. The system does not extend to the site area.

3.3.2.5.7 Solid Waste

Mammoth Disposal Service, a private carrier, provides bin service on a contractual basis. The nearest sanitary landfill, a site leased from the Los Angeles Department of Water and Power, is located at Benton Crossing Road and is designated Class II, handling normal household refuse and construction debris. The Benton Crossing landfill has a projected lifespan of 25 to 30 years (WESTEC, 1986).

3.3.2.5.8 Utilities

The site is located outside of the water service area of the Town of Mammoth Lakes. A well which supplies non-potable water is located at the adjacent MP I site. The MP I plant receives electricity from the Southern California Edison Company. During 1986, the electrical substations serving the immediate area had a combined designed capacity of approximately 6.6 megawatts. The site area is currently served by the Continental Telephone Company (Contel) which has general offices and maintenance and switching facilities in Mammoth Lakes (WESTEC, 1986).

3.3.3 RECREATIONAL RESOURCES

The project area is three miles east of the town of Mammoth Lakes, which has approximately 5,000 permanent residents. Located at the junction of the Great Basin and the Sierra Nevada Mountains, the beauty and recreational resources of the area have made Mammoth Lakes a popular resort. The nearby Mammoth Mountain Ski Area has become the largest in the country, attracting over 17,000 persons at one time (POAT) during peak ski season (Morse, 1987).

Summertime recreation uses in Mammoth Lakes are estimated to attract over 1.5 million visitors-days per year (USFS, 1980). Outdoor recreational activities include backpacking, camping, fishing, mountaineering, swimming, and boating. There are two campgrounds near the proposed site for MP II & III. The Sherwin Creek Campground is one mile southwest of the site and the Shady Rest Campground is three miles west of the site. There are approximately 32,700 visitors-days at Sherwin Creek and 92,200 visitors-days to Shady Rest annually (Lloyd, 1987).

Hot Creek Hatchery, known for developing a unique strain of rainbow trout, is three miles east of the site at the headwaters of Hot Creek. These trout are spawned in the fall, and by the following spring their progeny have grown to approximately six inches in length and are ready for stocking in local streams and lakes. Hot Creek Hatchery raises over 600,000 catchable size trout, and one million fingerling trout for stocking in the Inyo-Mono area annually (USFS, 1981). Immediately east of the hatchery, Hot Creek Ranch offers trophy trout fishing from May 1st to October 30th. At the ranch there are nine to 11 cabins available each season with five-person occupancy. During the fishing season the ranch averages 15,000 to 20,000 visitor-days (Millikan, 1987). The Hot Creek recreational area also contains Hot Creek Gorge, where hot springs emerge in Hot Creek. It is a favorite recreational spot for visitors to the Mammoth area and is open to the public throughout the year from sunrise to sunset. Peak use of the hot springs is during the summer months when up to 300 individuals at one time use the bathing area (Lloyd, 1987). All totaled, Hot Creek averages 95,000 recreational-visitor-days for swimming, fishing, site seeing and guided tours (Lloyd, 1987).

Dispersed recreational activities near the project area include camping, wood collecting, jogging, bicycling, snowmobiling, and deer hunting. The area bounded by Hot Creek, Highways 203 and 395, the Sherwin Creek recreational area, and Convict Lake, was visited by approximately 3,000 game hunters during the 1986 season (Morse, 1987). There are no existing recreational facilities within the project area. However Forest Road 3S05, Highway 395, and State Route 203 are near the proposed site and serve as the main access roads for the various recreational activities in the Little Antelope Valley.

3.3.4 TIMBER RESOURCES

The proposed project is located on the southern edge of an area within the Inyo National Forest which is managed for commercial timber production. Species which are managed for timber harvest include Jeffrey pine, red fir, white fir, western white pine, and lodge pole pine. Six of the eight well sites proposed for USFS land are located in Jeffrey pine forest. The other two sites are located partially in Jeffrey pine forest and partially in sagebrush scrub. The facilities proposed for private property are less likely to affect timber. The eastern third of the plant site and one well site is in a Jeffrey pine forest. The other areas to be cleared have little timber. Some Jeffrey pine on the eastern end of the project area may have commercial value; however, the proposed project area is not located on land currently managed for commercial timber production. No timber volume measurements have been completed within the proposed project area (McLean, 1987).

3.3.5 RANGE RESOURCES

The USFS land proposed as part of the project is within the Long Canyon Unit of the Hot Creek Grazing Allotment. This allotment is under permit to Miller and Wood and is administered by the Inyo National Forest. Although the private property is not part of the allotment, most of it is not fenced and is in fact used as part of the range. On a unit-wide average, 6.1 acres of land are required to support one (1) animal for one (1) month's time, an animal month or AM. Each AM returns approximately $1.36 to the federal government. Approximately 37 animals graze the Long Canyon unit, generally between August 15 and August 25, resulting in an output for the entire unit of approximately 91 AMs. Land within the project area is considered less suitable for grazing than the average land within the Unit as a whole (McLean, 1987).

3.3.6 CULTURAL RESOURCES

The archaeological record of the study area indicates that this portion of the Sierra experienced varying degrees of human occupation over the last 9,000 years. Site data suggest that a wide variety of spatially overlapping, but potentially discrete prehistoric land-use activities were undertaken in the area. Such activities included, but were not limited to, the production, use and exchange of lithic tools and blanks, collection of a wide variety of floral and faunal resources, and maintenance of residential bases. Similar situations may be observed at other locations in the Sierra and Great Basin region where the prehistoric inhabitants utilized a broad range of plant and animal resources as conditions changed throughout the year. Convenient access to resources located in varying environmental zones at different times of the year was implemented by frequent moves among the various regional microenvironments.

An intensive cultural resources assessment has been completed for the general project area as part of an earlier geothermal study (WESTEC, 1986). The literature/records search, undertaken by the California Archaeological Inventory, Eastern Information Center, revealed the presence of approximately 30 previously recorded sites within several square miles of the project area. The subsequent field reconnaissance of 640 acres surrounding the proposed project area, conducted by Far Western Research Group, Inc. (Hall, 1986), revealed the presence of eight additional archaeological sites.

The cultural resources investigations (Hall, 1986; WESTEC, 1986) indicate that the project area was occupied briefly on several occasions throughout the Holocene. The cultural activity appears to have been restricted to primary stoneworking (blank production) of obsidian nodules from the surrounding Casa Diablo obsidian source area. Occasional processing of foodstuffs is supported by the presence of groundstone and flaked lithic tools. Using obsidian hydration techniques to date materials from a site located just south of the proposed MP II & III development, two principal episodes of obsidian stoneworking are suggested; ca. 3400-1300 B.P. and ca. 1900-1000 B.P. Although useful scientific data was recovered from these investigations, none of the archaeological sites is considered eligible for nomination to the National Register of Historic Places.

There are no recorded cultural resources on or in close proximity to the proposed geothermal development of MP II & III. Temporary Site No. 8, a tent or cabin pad and an obsidian debitage scatter measuring approximately 785 square meters, is located roughly 200 meters to the north of proposed geothermal well development. Temporary Site No. 9, a low-density obsidian debitage scatter measuring approximately 1,237 square meters, is located roughly 175 meters to the northeast of proposed geothermal well development.

3.3.7 TRANSPORTATION AND ACCESS

Regional access to the project area is provided by Highway 395, the major road along the eastern side of the Sierra Nevada. In the immediate area, it is a divided, four-lane highway. From Highway 395, the project area is reached by traveling northeast on State Route 203, a paved two-lane road, for less than one-half mile to Hot Springs Road, County road no. 346A, also a paved two-lane road. Both Hot Springs Road and State Route 203 east of Highway 395 are lightly traveled. A network of dirt roads used to reach existing wells for the MP I geothermal power plant and the SCE substation lead directly to the MP II & III plant sites and to within 400 feet of proposed wells. The unimproved, single-lane road which provides access to the SCE substation would be used to access the proposed production wells for MP III. This road connects Hot Springs Road with USFS road 3S05 and is used by recreational users in the area as a shortcut between the two roads.

4.0 IMPACTS AND MITIGATIONS

4.1 PROPOSED ACTION

4.1.1 PHYSICAL ENVIRONMENT

4.1.1.1 Geology, Geologic Hazards, and Soils

4.1.1.1.1 Geology and Geologic Hazards

Unless otherwise cited, the information in the following section was taken from the Environmental Impact Report written by WESTEC (1986) to evaluate the Mammoth/Chance geothermal project, proposed for a site about three miles east of the MP II & III site.

Impact: Fault rupture from recent earthquakes in the region has occurred principally along known faults within the area. The plants and wells lie in areas recently affected by surface faulting. Significant offset along known or unknown faults over which project facilities might be constructed could seriously disrupt operation of such facilities. Related impacts to the environment would result from the discharge of geothermal fluids, release of isobutane from the plant, or downed transmission lines.

Mitigation:

- The proper siting and design of project facilities can reduce or eliminate the impacts due to surface fault rupture. Exploratory trenching in the area of the proposed power plants can be used to assure that major facilities, such as the cooling towers or generator, will not be sited on fault traces. Any project structures intended for human occupancy must be located at least 50 feet from the trace of active faults, in accordance with the Alquist-Priolo Special Studies Zones Act.

  Where avoidance of sensitive areas is not feasible for non-occupied structures, heavy equipment foundations should be designed to withstand a small amount of fault offset without undergoing structural failure. Similarly, pipelines and electrical transmission lines should be designed so that they can accommodate some fault offset.

- An emergency spill containment plan should be developed prior to project implementation. The plan should describe emergency shutdown procedures and plans for the regularly scheduled inspection, testing and maintenance of shutdown valves and controls.

Impact: Fault offset at depth may be a problem in a tectonically active area like the project site. To ensure high fracture permeability and an adequate supply of geothermal fluids, production wells are often drilled into or near fault zones. Movement along such faults could result in the rupture of a well casing and the discharge of fluids into shallow aquifers or to the surface.

Mitigation:

- The use of geophysical logs or other downhole instrumentation should be used to obtain good subsurface geological information. This information could then be used to identify faults. Wells should either be located so they do not pass through fault zones, or the faults should be sufficiently deep so that they are located below the cased portion of the well. Well casings above fault zones should be completely cased to that potential leakage into shallower zones can be minimized. Additionally, if there is good knowledge of the subsurface geology, remedial action taken on a ruptured well is more likely to be effective.

Seismic Groundshaking

Impact: As described in the Affected Environment, Section 3.1.1, the project site is in an area where earthquakes can result in horizontal ground acceleration of 0.4 to 0.6 g. This acceleration is approximately equivalent to groundshaking intensities of VII to VIII on the Modified Mercalli scale (Table 4-1). Intensities of VII to VIII would result in some damage to normal, well-built structures, but in little or no damage to structures designed to resist lateral forces.

TABLE 4-1: MODIFIED MERCALLI SCALE

Intensity	Observed Effects
I	Earthquake shaking not felt. People may observe marginal effects from large distance earthquakes without identifying these effects as earthquake-caused. Among them are: trees, structures, liquids, bodies of water swaying slowly or doors swinging slowly.
II	Shaking felt by those at rest, especially if they are indoors, and by those on upper floors.
III	Felt by most people indoors. Some can estimate duration of shaking, but mnay may not recognize shaking of building as caused by an earthquake. The shaking is like that caused by light trucks passing.
IV	Hanging objects swing. Windows or doors rattle. Wooden walls and frames creak.
V	Felt by everyone indoors. Many estimate duration of shaking, but still may not recognize it as caused by an earthquake. The shaking is like that caused by the passing of heavy trucks. Sometimes people may feel the sensation of a jolt, as if a heavy ball had struck the walls.
VI	Felt by every one indoors and by most people outdoors. Many now estimate the duration and the direction of shaking and have no doubt as to its cause. Sleepers awakened. Hanging objects swing, shutters and pictures move, standing autos rock, dishes rattle, glasses clink, some liquids spill, and small unstable objects are displaced or upset.
VII	Felt by everyone. Many are frightened and run outdoors. People walk unsteadily. Small church bells ring, pictures are thrown off walls, knick-knacks and books are thrown off shelves, dishes and glasses break, furniture moves or overturns, and trees and bushes rustle and shake. Masonry D damaged; some cracks in Masonry C./a/ Weak chimneys break at roof line. Plaster, loose bricks, stones, tiles, and architectural ornaments fall. Concrete irrigation ditches damaged.
VIII	Difficult for people to stand. Shaking noticed by auto drivers. Waves on pond. Water turbid with mud. Small landslides occur. Furniture is broken.
IX	People are thrown to the ground and there is general fright. Changes occur in flow and/or temperture of wells and springs. Cracks occur in wet ground. Steering of autos affected. Branches broken from trees. Masonry D destroyed; Masonry C heavily damaged, sometimes with general collapse; Masonry B seriously damaged. General damage to foundations. Frame structures, if not bolted, shifted off foundations. Reservoirs seriously damageed. Underground pipes broken.
X	General panic among population. Conspicious cracks in ground. Sand or water fountains ejected. Most masonry and frame structures destroyed along with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, and embankments. Railroads slightly bent.
XI	General panic. Large landslides. Water thrown on banks of canals, rivers, other bodies of water. Sand and mud shifted horizontally on flat land. General destruction of buildings. Underground pipelines out of service. Railroads bent significantly.
XII	General panic. Damage nearly total. The ultimate castastrophe. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into air.

/a/ Masonry A: Good workmanship and mortar, reinforced, designed to resist lateral forces.
Masonry B: Good workmanship and mortar, reinforced.
Masonry C: Good workmanship and mortar, unreinforced.
Masonry D: Poor workmanship and mortar and weak materials, like adobe.

Mitigation:

- Although it may be cost prohibitive to build all project facilities to withstand the predicted horizontal ground accelerations, structures would have to be designed to ensure that partial failure would not endanger the lives and safety of plant personnel or any other people who would be near the plants. It is recommended that the project design be reviewed by structural engineers experienced in earthquake engineering, not only to reduce hazards but to ensure a structure which would withstand seismic activity and thereby protect the investment in the project.

Volcanic Hazards

Impacts: The most likely volcanic hazard that would disrupt commerce and human activity in the project area is an ash fall from an eruption of one of the rhyolite volcanoes to the west. Periods of eruptive activity are infrequent, but if one were to occur, the project area would likely be blanketed with one to five inches of pyroclastic sand or ash. Ash can disable machinery and engines by clogging fuel and air filters and by causing rapid wear of moving parts. It can also short circuit electrical equipment and clog filters in air- or water-supply systems. Overall, the ash fall effects are disruptive to normal activity, but experience from Mount St. Helens shows that in areas which receive two inches or less of ash fall, most facilities resumed normal operation within one year.

A much more infrequent volcanic hazard, and one which has not occurred at the site for at least 50,000 years, is that posed by rapidly moving pyroclastic flows that travel away from the volcanic vent. So far, no major deposits from such events have been identified in the project area.

Mitigation:

- In the event of ash falls or pyroclastic flows from within Long Valley caldera, vehicle and airplane access to the area would probably be curtailed for several days. Utility service would probably be disrupted and the prediction of an impending eruption could lead to road closures in the area. To allow for this possibility, project facilities should be designed so that if personnel are unable to reach the power plants, a hazardous condition would not exist. As in the case of reducing fault rupture impacts, effective emergency shutdown procedures should be established, and shutdown valves and other controls regularly inspected, tested, and maintained.

- Impacts due to a large eruption in the immediate project area are essentially unmitigable. If sufficient warning exists, the emergency shutdown procedures could be implemented and the site evacuated.

Non-Seismic Ground Deformation

Impact: The amount of uplift and tilt in the project area is imperceptible without use of precision geodetic leveling instrumentation and should have no effect on the facilities or operations proposed there.

Mitigation:

- Proposed facilities should be designed so that small ground surface tilts (on the order of 0.001 feet/feet) will have no effect on operation of the plants.

Impact: The planned reinjection of spent geothermal fluids should minimize the likelihood of induced ground surface subsidence. Further, the fractured rhyolite rocks comprising the geothermal reservoir are not expected to be highly compressible. No deep subsidence impacts attributable to the project are foreseen.

Mitigation:

- None is necessary.

4.1.1.1.2 Soils and Erosion

Impacts: Construction of the power plants, access roads, well sites, pipelines and transmission lines would result in soil disturbance. The expected amount of total disturbance is approximately four acres for the power plant and 20 acres for well sites. About 1,800 feet of access roads in addition to the existing dirt roads would be built; this would result in disturbance of approximately one acre. Access roads would be sited to avoid cultural and biological resources. Installation of pipelines would disturb an additional one-half acre. Total site development would result in the temporary disturbance of no more than 26 acres. Most of the new access roads would be built on USFS land and used to reach the injection wells for MP III; the other areas could be reached on existing dirt roads which lead to the SCE substation and existing wells for MP I. After completion of construction and revegetation, about five acres of dirt access roads and cleared areas around wells would remain unvegetated for the life of the project. Table 4-2 summarizes the disturbed area by land ownership.

TABLE 4-2: APPROXIMATE ACREAGE OF DISTURBED SOIL ON PRIVATE AND USFS LAND

Units	USFS (acres)		Private Land (acres)	
	Short-Term	Long-Term	Short-Term	Long-Term
Power Plants	0.0	0.0	4.0	4.0
Wells/a/	10.0	4.0	10.0	4.0
Access Roads	0.7	0.7	0.3	0.3
Pipelines	0.3	0.0	0.2	0.0
TOTAL	11.0	4.7	14.5	8.3

/a/ 1.25 acres/well for short-term disturbance and 0.5 acres/well for long-term.

SOURCE: Environmental Science Associates, Inc.

The erosion potential from the proposed surface disturbance could become significant if proper precautions are not taken. Receptors for erosion and sedimentation from the project include Hot Creek and subsequently Mammoth Creek. Surface water leaving the site flows through the unnamed intermittent creek draining the Casa Diablo area for one-quarter mile before reaching Mammoth Creek. This provides sufficient time for silt and sand to settle out of the stream before they reach the sensitive receptors in Mammoth Creek; however, clay-sized materials would stay in suspension longer than the coarser particles.

The Lahontan Regional Water Quality Control Board (RWQCB) has established guidelines for erosion control for developments in the Mammoth Creek Watershed above the

7,000-foot elevation. (The MP II & III site lies at an elevation of approximately 7,200 to 7,400 feet.) These guidelines require a report of waste discharge from developers for commercial developments disturbing more than one-quarter acre of land. The RWQCB would then establish waste discharge requirements to ensure that proper control measures for the protection of water quality are taken during all phases of the proposed development. In satisfying these requirements, potential impacts from erosion can be greatly reduced. The impact is extremely difficult to eliminate completely since erosion control measures sometimes require a period of time to become effective (WESTEC, 1986).

Mitigation Measures Proposed as Part of the Project:

- During production and injection field drilling and testing activities, well sites would be bermed to contain minor spills on location. Sites would be graded to direct runoff to sedimentation basins or the mud/reserve pit.

- The power plant site would be diked and drained to a permanent catch basin to collect plant site runoff. The catch basin would also serve as an emergency containment basin in the event of a significant geothermal fluid system upset or spill.

Mitigation Measures Required by the RWQCB: The applicant would prepare a report to be submitted to the RWQCB incorporating the following measures, as appropriate to reduce the impacts from erosion and sedimentation.

- Drainage collection, retention, and infiltration facilities shall be constructed and maintained to prevent the transport of runoff from a 20-year, one-hour design storm from the project site. (The 20-year, one-hour design storm for the Mammoth Lakes area is equal to 1.0 inch).

- Surplus or waste material shall not be placed in drainage ways or within the 100-year floodplain or surface waters.

- All loose piles of soil, silt, clay, sand, debris, or earthen materials shall be protected in a reasonable manner to prevent any discharge to state waters.

- Dewatering shall be done in a manner so as to prevent the discharge of earthen material from the site.

- All disturbed areas shall be stabilized by appropriate soil stabilization measures as soon as possible. A specific plan for the stabilization of soils disturbed by project activities should be completed prior to construction.

- All work performed between October 15 and May 1 of each year shall be conducted in such a manner that the project can be winterized within 48 hours.

- Where possible, existing drainage patterns shall not be significantly modified.

- After completion of a construction project, all surplus or waste earthen material shall be removed from the site and deposited at a legal point of disposal.

- Drainage swales disturbed by construction activities shall be stabilized by the addition of crushed rock or riprap as necessary or other appropriate stabilization methods.

- All nonconstruction areas shall be protected by fencing or other means to prevent unnecessary disturbance.

- During construction, temporary erosion control facilities (e.g., impermeable dikes, filter fences, hay bales, etc.) shall be used as necessary to prevent discharge of earthen material from the site during periods of precipitation or runoff.

- Revegetated areas shall be continually maintained in order to assure adequate growth and root development. Physical erosion control facilities shall be placed on a routine maintenance and inspection program to provide continued erosion control integrity.

- Where construction activities involve crossing and or alteration of a stream channel, such activities shall be timed to occur during the period in which streamflow is expected to be lowest for the year.

Mitigation Measures Recommended by This Report:

- Construct all roads to USFS standards.

- New access roads to injection wells MPI 42-32, MPI 42A-32, MPI 42B-32, and MPI 42C-32 should follow the contour of the hillside, where feasible, so that erosion from new road surfaces would be lessened. (The botanically sensitive rhyolite buckwheat scrub in the area should also be avoided by the access roads.)

- No more than one-quarter acre of disturbed soil unprotected by physical erosion control facilities should be allowed at any one time. When one-quarter acre has been graded or cleared, the erosion control measures should be in place before additional surface disturbance is allowed.

- Stockpile soil from areas scheduled for grading or areas in which soil would be severely compacted. The soil could then be used during revegetation.

4.1.1.2 Water Quality and Hydrology

This section is summarized from the separate report on hydrology available from the Mono County Energy Management Department. The discussion covers three major types of environmental consequences due to increased production of geothermal fluid at Casa Diablo: 1) Degradation of surface water quality; 2) depletion of shallow fresh groundwater; and, 3) potential reductions in thermal spring flow or temperature.

4.1.1.2.1 Surface Water Quality

Impact: Spills of geothermal fluid resulting from a large pipeline rupture would be the most serious potential event. If a large pipeline carrying the entire plant capacity of geothermal fluid (approximately 5,000 gpm at 335°F) ruptured, a loss of several thousand gallons could result even as various pumps are automatically shut off. This includes spillage from pipes located up-gradient of the broken line which could drain out. If the breakage occurred on the site of the power plants, the spilled fluid would be contained by a system of dikes and a catchment basin. Outside the plant site, the fluid would flow into the existing unnamed streambed and subsequently into Mammoth Creek. The amount of spilled geothermal fluid that would reach the creek during such a spill is difficult to predict. Approximately 15% would discharge from the broken pipe as steam. Further reduction in volume would occur due to evaporation and infiltration into soils. The temperature of fluid from a burst pipeline would drop to approximately 200°F upon discharge from the open pipe due to a reduction to atmospheric pressure. Additional temperature losses would occur as the fluid flowed over the ground surface.

Temperature effects, though likely to be short-term, would be the most significant impact. The chemical content of the spilled geothermal fluid could cause short-term changes to creek water chemistry, but the precise concentration would be difficult to estimate. The chemical content of the fluid is low in Total Dissolved Solids (TDS) and would not likely have a significant impact for a short term event. Approximately 760 gpm of fluid from Casa Diablo wells was purposely directed to the creeks for 39 days in 1962 by a former operator. While this caused concern about effects of long term discharge and potential buildup of trace elements in the potable water supply at Crowley Lake, no catastrophic or lasting effects to the creeks or lake were documented (CDWR, 1967 and 1973; Setmire, 1984).

Similarly, a well blowout, though very unlikely, could result in a loss of drilling fluid and 200 to 500 gpm of geothermal fluid. The potential for creek contamination from loss of drilling fluid, such as from a pit or tank, would probably not result in any significant increase in temperature to Mammoth or Hot Creeks. Since no use of toxic additives for drilling is proposed, the only potential impact to creek waters would be a short period of turbid flow during the dispersal of the drilling fluid. Any residual fluid or solids remaining on the ground surface would be removed during cleanup operations and should not result in environmental damage. A blowout would probably have less impact than accidental thermal fluid discharge.

Mitigation Measures Proposed as Part of the Project:

- A detailed blowout contingency plan will be developed, including blowout prevention equipment required during drilling. In addition, at least 10,000 gallons of cold water would be stored on the well site to quench the well should a blowout occur during drilling. At least 50,000 gallons would be available during power plant operation.

- Regular testing and maintenance of automatic pump shutdown system would allow proper operation of equipment to prevent large scale spills of geothermal fluid due to pipeline rupture.

- Containment dikes and catchment basins should be adequately maintained to prevent erosion.

Impacts: Surface water could be contaminated by runoff from soils previously contaminated by leakage or spills of fuels and other chemical compounds used on the site. The potential for the latter is more likely during well drilling and power plant construction phases due to the presence of machinery, fuels and chemical compounds that would be stored and used on site.

Mitigation Proposed as Part of the Project:

- Mitigation measures for various spills and a detailed spill contingency plan would include immediate removal of spilled fluid by pump trucks for proper disposal, building containment dikes with heavy equipment, and removal of contaminated soils. Cleanup is to begin immediately along with notification of appropriate public agencies.

Mitigation:

- Follow RWQCB requirements for storage of hazardous materials.

- Regular site maintenance, cleanup, vehicle maintenance, and proper storage and handling of potentially hazardous materials should prevent significant contamination of soils or surface runoff.

4.1.1.2.2. Shallow Fresh Groundwater

Impacts: It is unlikely that any significant influence on shallow groundwaters in nearby areas will result since the particular aquifer from which shallow fresh water is produced is probably limited to the Casa Diablo area. No connection is believed to exist between this groundwater aquifer and the more extensive shallow groundwaters in the south caldera area, for example, along the course of Mammoth Creek.

Mitigation:

- None is necessary.

4.1.1.2.3 Hydrothermal Resources

Potential impacts of geothermal power production on surface thermal fluid resources (springs and other manifestations) near Casa Diablo are difficult to assess without a more thorough understanding of the geothermal reservoir. Without accurate estimates of reservoir permeability, storage, potential recharge and regional fluid movement no accurate prediction of consequences of development of MP II & III can be made. Even less is known about potential thermal reservoirs or the source of fluid for the Hot Creek Gorge and Hot Creek Hatchery areas. More detailed reservoir characterization would assist in calculating or estimating potential adverse effects on springs. Potential effects could be estimated only if hydraulic connection between the geothermal reservoir at Casa Diablo and the source of the springs is established.

Two distinctly different models of subsurface thermal fluid origins and flow directions have emerged as discussed in the Affected Environment. The Upwelling/Fracture Flow Model implies that there is no hydraulic communication between the Casa Diablo area and the Hot Creek Hatchery and Hot Creek Gorge area, which in effect precludes potential adverse impacts. The Lateral Flow Model suggests relatively widespread lateral hydraulic communication in the south and southwest caldera region in one or more zones. The latter model allows consideration of the potential adverse impacts to hot springs which could result from continued or increased production and injection of geothermal fluids.

Simulated Reservoir Performance Calculations

Two different methods were used to estimate the effects of production and injection on nearby springs under the assumption that hydraulic communication does exist. Both were based on highly simplified models. The first uses a computer model which simulates a reservoir with no discontinuities or barriers and with uniform characteristics in all directions. This model was used to estimate the pressure changes (water level changes) in the hydrothermal reservoir corresponding to surface locations of interest. The second calculation was used to predict the distance that cooler, injected fluid would move outward from Casa Diablo.

Pressure Response Modeling

The computer model used for the calculations presented below has been successfully applied to predict pressure behavior in other fractured geothermal reservoirs and is used here to provide a quantitative analysis of production and injection at Casa Diablo under the following simplifying assumptions:

- lateral flow is uniform;

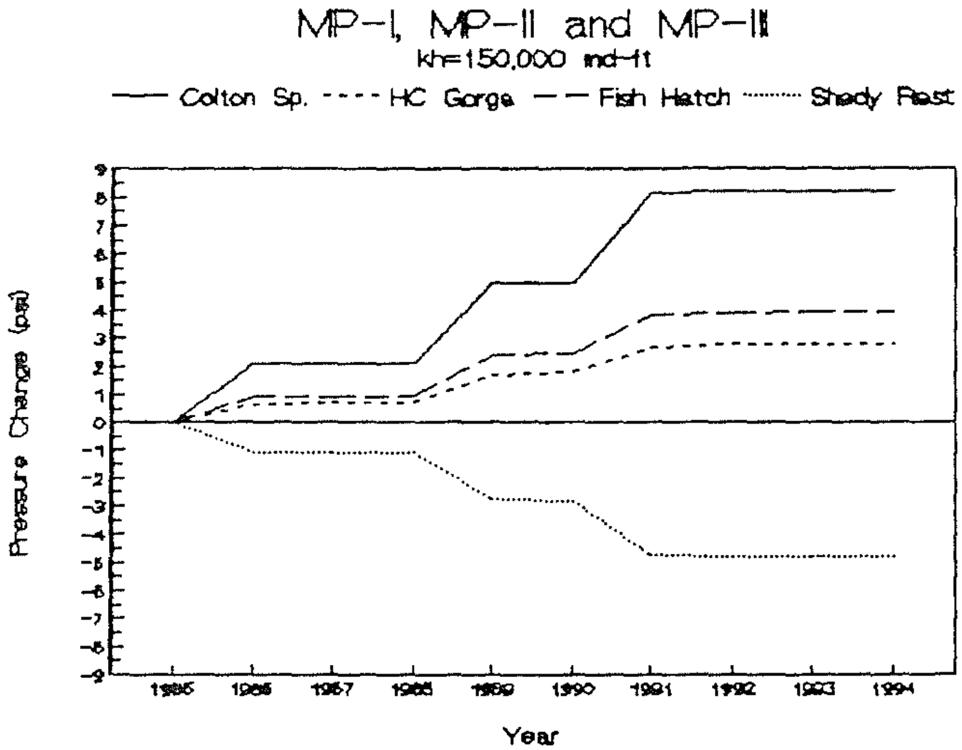
- there is no hot water recharge to the producing reservoir; and

- there is complete hydraulic communication between injection and production zones.

Computer calculations were run for two different values of the reservoir permeability thickness product (kh) of kh = 150,000 md-ft and 500,000 md- ft./1/ This parameter is the product of average reservoir permeability and average reservoir height. It is a measure of how much pressure drop will occur for known, net flow out of the reservoir. These values constitute approximate upper and lower bounds based on previous work (GeothermEx, 1986), and provide a reasonable range of values for the subsurface fractured rock in this area of the caldera.

First, production from three MP I wells totalling 3,800 gpm at 335°F with 100% injection was assumed. A simulation was performed which included the additional production/injection for MP II & IIII (approximately 10,000 gpm) beginning in 1988. For all calculations discussed, power plant operations were assumed to begin in early 1985 for MP I and mid-1988 for MP II & III. The computer calculated the reservoir pressure response for the areas underlying Colton Spring (CS), Shady Rest (SR), Hot Creek Hatchery (FH) and Hot Creek Gorge (HCG) over several years, after MP I startup.

The model does not predict the relationship between the calculated reservoir pressure changes and the actual effect on the surface features.



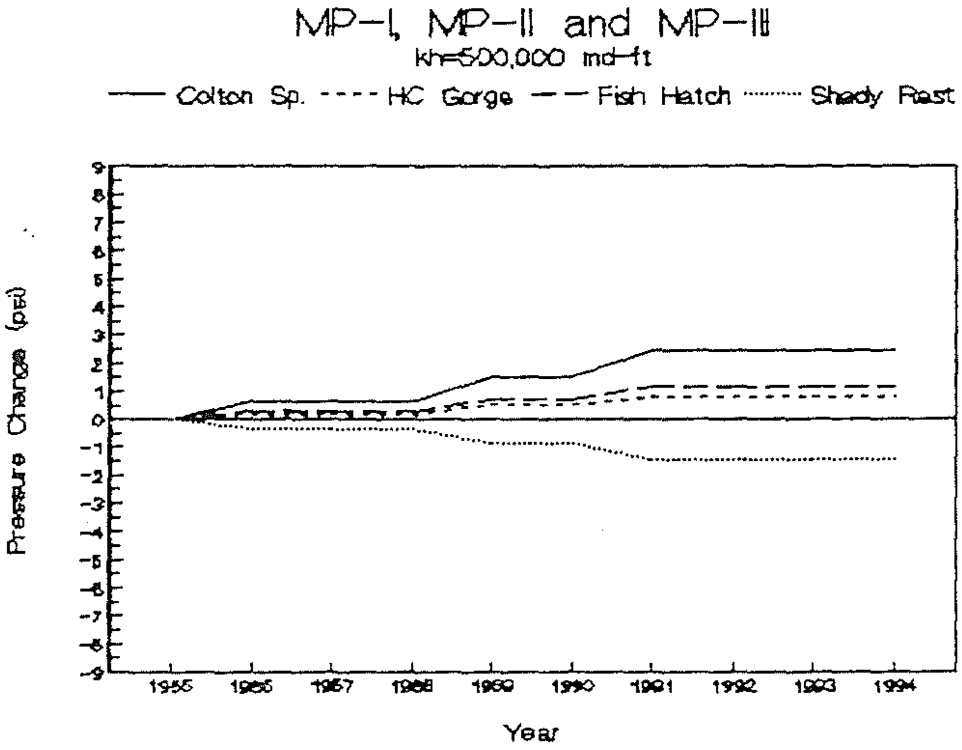


FIGURE: 4-1
Pressure Changes in Subsurface Reservoir
Due to Operations of MP I and MP II & III

SOURCE: BGI, 1987

The results, shown in Figure 4-1, indicate that the 100% injection of produced fluids on the east side of Casa Diablo prevents pressure in the reservoir from declining at the Hot Creek Hatchery or Hot Creek Gorge area. However, pressure drawdown would be predicted for the reservoir beneath Casa Diablo Geyser, which is close to the center of production. Slight decreases in reservoir pressure are predicted for the Shady Rest Well area. The model indicates most subsurface pressure effects will occur in the first few years of power plant operation with only slight pressure changes occurring at later times. This effect is due primarily to 100% injection of produced fluid. The calculation using kh=500,000 md-ft is believed to be closer to the probable value than 150,000 md-ft. The higher kh value gives lower effects (in the reservoir) due to power plant operations. The results of the calculations for the kh=500,000 md-ft case are more consistent with the apparent low reservoir drawdowns presently observed in the existing MP I wells and the continued, though declining, Casa Diablo spring flow. Based on experience in other geothermally active areas, this value of kh is relatively large, but not unreasonable for pervasively fractured volcanic rock.

Any combination of effects not accounted for in this model could significantly affect potential reservoir pressure responses. For example, natural subsurface recharge of hot water to the reservoir could reduce the magnitude of calculated pressure changes. It is also possible that reservoir pressure could increase if free movement of fluid occurs between production and injection zones. However, barriers to the movement of fluid could increase calculated drawdowns.

No attempt was made to calculate the pressure changes beyond nine years since the model is at best a rough estimate due to lack of available data. If calculations were extended for the full 30-year power plant life, no significant change in the results would be predicted unless other geothermal power plants were to be constructed.

As mentioned previously, no precise relationship between spring flow rate and the reservoir pressure is known. Hence, predicted reservoir pressure changes cannot be interpreted directly as increases and decreases in spring flow. The location of boiling and condensation in the subsurface would need to be modeled in detail for a realistic appraisal of the relationship.

Bulk Model Calculation

A second calculation was performed in an attempt to estimate the distance that the cooler injected fluid would move from Casa Diablo and therefore, predict the potential for interference of cooler injected fluid with hot regions beneath springs. This so-called "bulk-model" calculation is based on assumptions of rock thermal properties, porosity, and displacement of fluid outward in an approximately uniform cylindrical front. An injection fluid temperature of 300°F and a reservoir thickness of 500 feet were also assumed. Continuous injection of 3,800 gpm for MP I and 10,000 gpm for MP II & III was assumed.

The hydrodynamic front would expand outward at a faster rate than the thermal front. The calculated position of the thermal front indicates that the distance cooled fluid moves away from the injection wells is approximately 1,400 feet in 30 years.

This calculation in simplistic, but useful for comparison with other models. In reality, fractured rock could allow preferred flow paths to carry injected fluid far beyond the calculated fronts. However, results indicate that a very large distortion of the calculated front would be required for the lower temperature fluid to travel as far as Hot Creek Hatchery (approximately three miles distant) or Hot Creek Gorge (about five miles). It is also significant that gravity segregation has not been accounted for in this calculation. This effect allows colder fluid to sink deeper into the reservoir, decreasing the probability of near surface consequences. Gravity segregation models have been used to study other reservoirs and could be studied in more detail as new data on the reservoirs become available. The assumed porosity of five percent may be high for fractured rock, but no estimates of porosity at Casa Diablo are currently available. The reservoir thickness of 500 feet may be low based on some geological evidence. These two parameters, porosity and reservoir thickness, have compensating effects in the calculations, and using slightly different values should not alter the conclusions given below. It is possible that the effective injection zone thickness is greater than the 500 feet assumed for this calculation. This could allow a decrease in the radial extent of the hydrodynamic and thermal fronts.

A separate calculation related to distortion of the bulk model thermal front was performed. It is based only on the subsurface hydraulic gradient which may induce lateral west to east flow. The effect of this gradient would be to allow greater movement of the injected fluid down-gradient to the east and is not accounted for in the bulk model. As previously mentioned, there is some debate as to whether such a lateral west-to-east flow exists. Assuming it does exist for the purpose of estimating a worst case scenario, a rough estimate of its effect can be calculated from the regional groundwater gradient. A fluid velocity of 0.06 ft/day was calculated based on a horizontal permeability corresponding to kh= 500,000 md-ft. used in the computer model and a value for the local groundwater gradient map of 0.0135 ft., estimated from the water level contour map of Farrar et al. (1985).

The results indicate that fluid moving from Casa Diablo would take about 100 years to reach Hot Creek Hatchery and 150 years to reach Hot Creek Gorge. These results are based on the assumption that lateral west-to-east subsurface flow occurs in the region and no provision is made for the effect of preferred flot paths, which are often associated with fractured reservoirs. However, calculations of the movement of fluid in the subsurface induced by the local groundwater gradient does not take into account reheating of injected fluid through contact with hot reservoir rock.

If reinjected fluids reach the subsurface zones below the surface springs, it may not necessarily result in the cooling of springs or in decreasing flowrates. This could delay the arrival up to 10 times of the cooler winter as illustrated in the bulk model. The estimated position of the thermal front including some distortion by lateral flow indicates breakthrough of cool injection fluid is not likely to be a potential threat to existing springs.

Impacts: It is difficult to predict the effects on surface thermal features resulting from production/injection operations at the proposed project and the existing MP I power plant. The simple model calculations described here indicate that, assuming hydraulic communication exists, the potential for subsurface impacts to extend three to five miles to Hot Creek Hatchery and Hot Creek Gorge is very low. Also, subsurface effects may not be related directly to thermal springs. Special circumstances exist at each area, such as those at the hatchery springs, where it is estimated that less than five percent of the flow is thermal water. The temperature of the thermal fluid component of these springs is unknown, hence it can only be estimated that a loss of the entire thermal component could result in a lowering of average spring temperatures by 2° to 3°C (Sorey, 1987a). This effect cannot be considered a certainty, however. Only continued monitoring of springs and wells may allow cause and effect relationships to be established.

Mitigation:

Since a precise analysis of hydrologic effects due to increased geothermal development at Casa Diablo is not possible on the basis of current data, a closely controlled program of surface and subsurface fluid monitoring should be established. This program should include measurement of chemistry, flowrate and temperature of important surface features; temperature, pressure and, flow rate and chemistry of one or more observation wells; injection well pressure; and production well temperature, pressure, flowrate and chemistry. Well test data collected during the development of the wellfields for power plants is usually confidential, but could be made available to an appropriate agency for review. Continuous monitoring and periodic sampling of various features is already underway by the USGS and others (Farrar et al., 1985 and 1986). A similar though less comprehensive program is likely to be proposed by Mammoth Pacific. Table 4-3 lists the monitoring activities that have been proposed and those recommended by this study.

The proposal includes a significant upgrade in the accuracy of downhole pressure measurement during testing and production of wells, which should result in more accurate estimates of reservoir parameters than presently available. This and other proposed monitoring should allow the application of more detailed models than the simplified versions used for calculations in this study. Calculations may then be upgraded and improved, and potential adverse consequences to the reservoir and/or springs can be reevaluated periodically.

It is recommended that a monitoring well be drilled at an accessible and permissable location chosen by an appropriate agency. A suggested location for this well would be between the County buildings and Well M-1. The primary function of the monitoring well would be to serve as early warning of reservoir pressure decreases or temperature decreases which may affect springs propagating toward the east or southeast. Without this means of detection, it may take several years for adverse impacts to be defined by measurements at the springs themselves.

TABLE 4-3: PROPOSED AND RECOMMENDED HYDROLOGIC MONITORING

Proposed by Mammoth Pacific	Recommended by this Report
SPRINGS:	
Casa Diablo North Spring (CDNS) Casa Diablo South Spring (CDSS) Casa Diablo Geyser (CDG) Colton Spring (CS)	Same; plus Hot Creek Hatchery AB, and H2,3 A representative Hot Creek Gorge spring
Quarterly Sampling: Temperature, Flowrate, pH, Chloride, TDS, Alkalinity Annual Sampling: Temperature, Flowrate, pH, Ca, Mg, K, Cl, F, TDS, SO_4, SiO_2, As, B, Li, Fe, Mn, Zn, Alkalinity	Sampling: Same; plus continuous flowrate and weekly temperature measurements at CDG, AB,H2,3, and the selected Hot Creek Gorge spring.
WELLS:	
Testing of New Wells: Liquid and gas sampling, measurement of flow-rate, and produced fluid temperature.	Same; plus Downhole flowing P/T surveys
Production Wells: Continuous measurement of produced fluid, temperature, pH, specific conductance, flowrate, downhole pressure. Quarterly chemical sampling.	Same; plus Access to temperature survey data if surveys performed.
Injection Wells; No monitoring proposed.	Weekly wellhead pressure. Approximately yearly downhole P/T surveys to fit in with plant maintenance and operating procedures. Spinner survey after power plant startup.
Monitoring Well: None proposed.	Monitoring well between the County buildings and Well M-1. Measurements: - Continuous downhole pressure or water levee. - Flow test after drilling with measurements as New Well above. - Allow access for periodic downhole sampling by others. - Annual downhole P/T surveys.

(Continued)

TABLE 4-3: PROPOSED AND RECOMMENDED HYDROLOGIC MONITORING (Continued)

Proposed by Mammoth Pacific	Recommended by this Report
Other: None proposed.	Annual downhole temperature surveys in Chance #2 or similar nearby well. Begin continuous water level or downhole pressure monitoring if significant changes are seen in above-mentioned monitoring well (if permissable and if no Mammoth Chance project proceeds).

SOURCE: Berkely Group Incorporated, 1987.

If properly sited, the monitoring well could more precisely detect changes in subsurface conditions propagating toward Hot Creek Hatchery and Hot Creek Gorge than may be possible by surface spring sampling and flowrate measurements. Locating an ideal site may be difficult given the variable geologic structure in the region and potential limits on property access. Given these constraints, there is no guarantee that such a well would be in hydraulic communication with either production or injection zones at Casa Diablo or fluids supplying surface springs of interest.

Also recommended are periodic temperature measurements in a deep well or wells near the Hot Bubbling Pool, such as Chance #2. This would have to be arranged with current well owners and would depend upon the status of the Mammoth/Chance project.

Existing background data collection should be continued to establish baseline values and ranges of temperature, pressure and chemical constituents which can be agreed upon by appropriate agencies. The data collected by the USGS and others thus far, presented by Farrar et al. (1985 and 1986), should allow general guidelines to be established which could then be updated as new data is added. Additional data would be helpful in delineating more precisely to what extent pressure, temperature, chemical and flowrate changes can be attributed to natural causes (e.g., tectonic strain and seasonal precipitation amounts) and what changes, if any, may be attributed to power plant operations.

If spring flows or temperatures were reduced in the Hot Creek area and it could be established that MP II & III power plant operations were the cause, the following mitigations could be pursued.

Mitigations:

- Participate in a hydrologic monitoring program as required by Mono County Energy Management Department.

- Provide thermal fluid from wells to restore original baseline flows and temperatures to the hatchery. It has been estimated that thermal water contributes no more than 5% to the flow at the hatchery, or about 450 gpm of the 9000 gpm used in hatchery operations. If operation of the MP II & III plants caused depletion of the geothermal resource so that hatchery operations were adversely affected, it would be possible to increase pumping from the reservoir by less than 5% of their combined pumping rate and supply the hatchery with 450 gpm of thermal water. This process would mitigate the impacts of depletion of the geothermal resource at the hatchery but would increase slightly the impact elsewhere.

- Heat water for Hot Creek Hatchery using a source of energy other than heat from geothermal fluids. Raising the temperature of the water used at the hatchery by conventional heating methods would be expensive. This is not likely to be a feasible mitigation. See the notes to Section 4.1.3.2, Socioeconomics, for a calculation of the cost.

- Supply geothermal water from a well to Hot Creek Gorge. At Hot Creek Gorge, wellhead and pipeline outflow could be constructed in such a manner as to be relatively inconspicuous, but such measures would not restore the scenic value and visitor appeal as it currently exists. Therefore, it is not a realistic mitigation for preservation of the recreational value of Hot Creek Gorge.

- MP II & III power plant operations could be reduced or stopped. Reducing or stopping the pumping of geothermal water at the power plant is not likely to result in immediate restoration of spring flow to background levels at springs which may be affected because of the time required for the system to recover.

NOTES - Hydrothermal Resources

/1/ The reservoir permeability thickness product is the average reservoir permeability, measured in millidarcies, multiplied by the thickness of the reservoir, measured in feet. A millidarcy is one-thousandth of one darcy, which is a standard unit of permeability equivalent to the passage of one cubic centimeter of fluid of one centipoise viscosity flowing in one second under a pressure differential of one atmosphere through a porous medium having an area of cross-section of one square centimeter and a length of one centimeter.

4.1.1.3 Noise

Three phases of the proposed MP II and III projects would generate noise in the vicinity of the Casa Diablo Hot Springs: construction, well-drilling and testing, and operations.

4.1.1.3.1 Construction Noise

Impacts: Noise from construction-related activities consists of both noise from heavy machinery used at the site and noise from transporting equipment and workers to and from the site. Construction of each of the MP II and III facilities would last about nine months, with no overlap of construction periods. During construction, heavy equipment would generate noise levels similar to those shown in Table 4-4. Occasional recreational users of adjacent forest as well as wildlife in the area may be affected by these temporary noise levels depending on topography and vegetation. Given existing topography and vegetation, noise from construction activities at the project site are not expected to impact any existing sensitive receptors. The peak noise level of 89 dBA, L_{eq}, due to excavation (at 50 feet) would be attenuated by distance alone to 47 dBA, L_{eq}, at the closest sensitive receptors; the County office buildings 1.25 miles to the east. Given existing topography and vegetation, noise from construction activities is not expected to impact any sensitive receptors such as schools, hospitals, churches, or libraries.

Mitigation:

- Use muffling devices on construction equipment. Optimal muffler design can reduce noise levels from diesel-powered earthmoving equipment by up to 10 dBA (Schomer et al., 1976).

TABLE 4-4: TYPICAL CONSTRUCTION NOISE LEVELS AT 50 FEET FROM COMMERCIAL/INDUSTRIAL CONSTRUCTION ACTIVITIES (dBA, L_{eq})/a/

Construction Phase	Average Noise Level (dBA, L_{eq})
Ground Clearing	84
Excavation	89
Foundations	78
Erection	85
Finishing	89

/a/ The L_{eq} is the average noise intensity over the measurement period. Its value tends to be influenced by loud intrusive noises.

SOURCE: Bolt, Beranek, and Newman. 1971. Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances. U.S. Environmental Protection Agency.

Impacts: Mammoth Pacific anticipates that up to 82 workers would be employed during a nine-month construction period. Many of these workers would live in Mammoth Lakes during the construction period and would travel State Route 203 and Hot Springs Road to the project site. Traffic noise along that corridor would be temporarily increased, but no sensitive receptors are located there. The peak noise level of 89 dBA, L_{eq}, due to excavation would be attenuated by distance alone to 47 dBA, L_{eq}, at the nearest sensitive receptors the county office buildings, 1.25 miles to the east. Individual drive-bys would generate noise levels of abvout 60 dBA at 10 feet. No sensitive receptors are nearby, but wildlife and passers-by could be affected.

Mitigation:

- Establish vanpools or carpools and limit construction activities (except drilling) to 7:00 a.m. to 4:00 p.m. This would reduce the total number of trips and would also reduce the noise levels at night.

4.1.1.3.2 Well Drilling and Testing Noise

Impacts: Well drilling noise results from a variety of sources including diesel engines, mud pumps, and electric generators. Drilling equipment would be operated 24 hours per day for 12 to 16 days at each of sixteen planned wells. Noise levels from well drilling have been estimated to reach 77 dBA, L_{eq}, at 100 feet (WESTEC, 1986). It is unlikely that more than one well would be drilled at any one time, but as many as two wells may be drilled simultaneously and noise levels as high as 80 dBA, L_{eq}, at 100 feet could be produced. This noise level could be annoying to wildlife and people in the vicinity, but would be attenuated by distance to 66 dBA, L_{eq}, at 500 feet and to approximately 44 dBA, L_{eq}, at the closest sensitive receptors, 1.25 mile to the east. Terrain and vegetation would further attenuate these temporary noise levels.

After being drilled, each well would be cleaned out by pumping geothermal fluids out of it for two to four hours. Cleanout would be followed by flow testing for about five days. Noise levels from cleanout and flow testing would probably range from 75 to 79 dBA, L_{eq}, at 100 feet (WESTEC. 1986). Attenuated noise levels would be similar to those described for well drilling.

Mitigation:

- None are required beyond those necessary to comply with county and OSHA regulations. The County will enforce GRO 4 noise regulations which require that noise levels not exceed 65 dBA, Le_{q}, at the lease boundary or 0.5 mile from the source, whichever is greater.

4.1.1.3.3 Operational Noise

Impacts: Noise levels generated by the MP II & III plants would be similar to levels generated by the existing MP I facility. Noise from the unmuffled MP I plant has been measured at about 76 dBA, L_{eq}, at 150 feet. Noise abatement devices have been shown to reduce noise levels by 10 to 12 dBA, L_{eq} (Asper, 1987b). The MP II & III plants would operate 24 hours per day, seven days per week, as does the MP I plant. Addition of two more plants with the capacity to generate noise levels similar to those produced by the MP I facility could result in a combined noise level four to five decibels louder than the

MP I plant, a noticeable increase. Distance, topography, and vegetation would attenuate noise from these facilities to a level below background noise levels at all sensitive receptors identified in Section 3.1.3.

Mitigation Proposed as Part of the Project:

- Noise-muffling devices are included in the design of the facilities. They have been shown to reduce noise levels by 10 to 12 dBA, L_{eq}.

Mitigation:

- Apply muffling devices to the MP I plant so that the background noise decreases to a level of 65 dBA at the project boundary or at a distance of 0.5 mile, whichever is greater.

4.1.1.4 Air Quality

The potential for geothermal resource development to adversely affect air quality exists during plant construction; well drilling, testing, and clean out; and plant operation. In addition, accidents may result in air pollutant emissions during any phase of development.

4.1.1.4.1 Construction

Impacts: Earthmoving and construction activities would generate large amounts of dust, degrading local air quality during two separate nine-month construction periods. A large fraction of the particulate matter generated by construction activities would settle out of the atmosphere rapidly and would not create a public health problem or affect the air quality of nearby Class I areas. Smaller particulate matter (PM_{10}) would remain suspended for a longer period of time and may create a health hazard or degrade visibility in nearby areas. Worst-case 24-hour PM_{10} averages at and near the site would exceed the state one-hour standard of 50 ug/m^3. Small amounts of CO, NO_2, SO_2, and hydrocarbons would be produced by fuel combustion. Use of paints and asphalt would also emit small amounts of hydrocarbons.

Air pollutant emissions generated by project development, operation, and accidents would probably not degrade the air quality of the John Muir Wilderness. Most of the wilderness area is at elevations above 8,000 feet, while the project site is at about 7,300 feet. The predominant westerly and northwesterly winds, along with nighttime downslope drainage, would divert pollutants away from the wilderness area and towards Long Valley. Daytime upslope and easterly Santa Ana winds may concentrate pollutants in the project area, but probably would not direct pollutants to the south and upslope into the wilderness area.

Mitigation:

- Construction sites should be wetted down during the development period at least twice a day, with complete coverage, and with enough water to moisten the ground surface. This measure would reduce dust by about 50%.

- Stockpiled materials and loaded trucks should be covered to avoid wind entrainment of dust. Trucks should not be overfilled and off-site spills should be cleaned up promptly.

- Exposed soil should be revegetated as soon as possible.

- Construction should be planned so that large, unvegetated areas are not left exposed to wind erosion for long periods. If large, unvegetated areas were exposed, solid barriers should be used around sites to reduce the quantity of dust entrained by the wind.

- Vehicle speeds at construction sites should be kept below 15 miles per hour, and overall vehicle travel on construction sites should be minimized.

- Water-based paints and architectural coatings should be used in place of oil-based materials to the extent feasible in project construction.

4.1.1.4.2 Well Drilling, Cleanout, and Testing

Eight well sites have been selected for development of production wells. Well drilling would typically require about 12 days per well, during which time criteria pollutants would be produced by the drill rig. H_2S and other noncondensable gases may be emitted intermittently on a temporary basis during drilling, although H_2S monitoring performed during drilling and testing of the MP I wells detected no H_2S emissions (Mammoth Pacific, 1986). The greatest potential for atmospheric emissions would be the occurrence of a well "blowout" as discussed in Section 4.1.1.4.4.

Impacts: H_2S may temporarily (two to four hours) be released during the cleanout and flow testing of wells, when geothermal fluids are pumped into large open containers. At an operational flow rate of 2,000 gallons per minute (gpm) for pumped flow (PLES, 1986) and a worst-case H_2S content of 8 milligrams per liter (mg/l) approximately 3.6 kg/hr of H_2S could be emitted from the containers. Such emissions would exceed the APCD H_2S emissions standard of 2.5 kg/hr/source.

The EPA-approved dispersion model PTPLU was used to estimate worst-case ground-level concentrations from this H_2S emission rate. To do this, several assumptions were made (see Table 4-5). Under these assumptions, estimated ground-level H_2S concentrations range from 0.1 to 4.1 parts per million (ppm) as shown in Table 4-6. These concentrations cover a range of stability conditions and wind speeds. The higher H_2S concentrations would occur during moderately stable to moderately unstable atmospheric conditions, at wind speeds ranging from 10 to 12 mph, conditions typical of the project area. These H_2S concentrations would exceed the state one-hour standard of 0.03 ppm, and would produce a noticeable "rotten egg" odor; they would not pose a health hazard and would not reach beyond the immediate vicinity of the well under normal conditions.

Mitigation:

- Limit drilling, cleanout, and testing activities to one well at a time. This measure would help prevent H_2S concentrations that could exceed county and state standards established to protect public health.

4.1.1.4.3 Operations

Impacts: After the initial cleanout and flow testing, all geothermal and working fluids would be contained in closed systems (emissions from potential accidents are discussed in Section 4.1.1.4.4). Geothermal fluids would not be exposed to the atmosphere at any time during normal operations. The isobutane working fluid would also circulate in a sealed system except during system charging, when isobutane may be released to the

TABLE 4-5: PTPLU MODELING PARAMETERS AND ASSIGNED VALUES

	Model Parameters	Assigned Value
1.	Gradual Plume Rise:	Not Included
2.	Stack Downwash:	Included
3.	Bouyancy-Induced Dispersion:	Included
4.	Wind Profile Exponents:	0.10, 0.15, 0.20, 0.25, 0.30, 0.30 for Stability Classes A through F respectively.
5.	Ambient Air Temperature:	289 °K (60 °F)
6.	Mixing Height:	396 meters (1,300 feet)
7.	Anemometer Height:	10 meters
8.	Receptor Height:	2 meters
9.	H_2S Emission Rate:	1.0 g/s (based on a fluid flow rate of 2,000 gpm and a maximum H_2S content of 8 mg/l.
10.	Emission Height:	3.8 meters (assuming that the tank is full)
11.	Exit Velocity:	0.1 m/s
12.	Tank Diameter:	3.2 meters (based on tank dimensions of 8' x 43')
13.	Exit Temperature:	450 °K (350 °F)

SOURCE: Mammoth Pacific; WESTEC, 1986; and Environmental Science Associates, Inc.

atmosphere. According to Walker (1987), the MP I plant experiences isobutane losses of about 250 to 1,000 pounds per day. This is a large amount of volatile organic compounds (VOC) hydrocarbons being released to the atmosphere in the form of gaseous hydrocarbons. This lost material is replaced once a month. Similar uncontrolled releases may be anticipated at the MP II & III plants.

TABLE 4-6: ESTIMATED MAXIMUM H_2S CONCENTRATIONS FOR WELL CLEANOUT AND FLOW TESTING

Stability Class	Wind Speed (mph)	Distance from Source (feet)	Maximum H_2S Concentration (ppm)
A	6.7	79	0.8
B	9.7	46	1.6
C	11.2	46	2.8
D	12.3	52	4.1
E	3.4	1,848	0.1
F	3.4	2,270	0.1

SOURCE: Environmental Science Associates, Inc.

Estimates of ground-level isobutane concentrations from system leaks were obtained with the computer model PTPLU. Estimates were made under the assumption that leaks occurring at the many valves and seals could be combined into a single source of combined magnitude (i.e. 250 to 1,000 lbs/day). Results of these calculations are shown in Table 4-7. They indicate that ground-level concentrations would not reach dangerous levels (1.8 to 8.4% of air) on days with very stable atmospheres and low wind speeds.

intermittent lubricating and fuel oil spills may emit small amounts of hydrocarbons, but these would not have a substantial effect on air quality. Air-cooled condensers would eliminate the possibility of cooling tower plumes, and the associated fog and ice formation except during the brief period when each well is flow tested.

Mitigation:

- GBUAPCD may require remedial control action with regard to the release of the isobutane working fluid into the atmosphere, so that no more than 250 pounds per day would be released.

TABLE 4-7: PTPLU MODEL RESULTS FOR CONTINUAL LEAKAGE OF ISOBUTANE /a/

Emission Rate (lbs/day)	Stability Class /b/	Wind Speed (m/s)	Ground-Level Concentration (ppm)
250	4	0.5	52
	5	1.3	26
	6	1.1	63
1,000	4	0.5	208
	5	1.3	106
	6	1.1	252
1,500	4	0.5	310
	5	1.3	159
	6	1.1	378
6,000	4	0.5	1,248
	5	1.3	636
	6	1.1	1,512

/a/ Values shown in Table 4-5 for model parameters are identical to those used for isobutane estimates except for parameters 2 (stack downwash was used), 9 (values given above), 10 (emission height was one meter), 12 (source diameter was an eight-inch valve), and 13 (exit temperature was 120°F).

/b/ Stability classes 4,5, and 6 refer to classes D, E, and F in the Pasquill-Gifford scheme and represent stable to very stable atmospheric conditions.

SOURCE: Environmental Science Associates, Inc.

4.1.1.4.4 Accidental Emissions

Impacts: A rare, but potentially important source of emissions during well drilling would be an uncontrolled release of geothermal fluids or a blowout. Indications are that natural flow from wells in the Casa Diablo Hot Springs area would be about 500 gpm. Given this flowrate and an H_2S content of 8 mg/l, H_2S emissions would be below the APCD standard of 2.5 kg/hr/well if a well were to blow. Computer modeling of ambient concentrations using the assumptions of Table 4-5, a 30-inch diameter well, an emission rate of 0.25 g/s (500 gpm at 8 mg/l H_2S), and an exit velocity of 0.02 m/s (500 gpm through a 30-inch diameter pipe) resulted in worst-case ground level concentrations as shown in Table 4-8.

TABLE 4-8: MAXIMUM AMBIENT H_2S CONCENTRATIONS DURING A WELL BLOWOUT

Stability Class	Wind Speed (mph)	Distance from Source (feet)	Maximum H_2S Concentration (ppm)
C	3.5	50	4.3
D	2.2	52	8.2
E	11.2	88	0.9
F	11.2	79	2.3

SOURCE: Environmental Science Associates, Inc.

These concentrations would exceed state and local emission standards, but would pose no significant health affect. Odor would be noticeable within the plant boundaries.

During plant operation, a severe accident such as a pipeline rupture may vent geothermal fluid. The anticipated production rate of 5,000 gpm and H_2S content of 8 mg/l could result in emission rates of approximately 9 kg/hr, which would exceed the one-hour APCD standard. The state one-hour ambient air quality standard would also be exceeded. PTPLU model results for this scenario are shown in Table 4-9. The results indicate that ground-level concentrations would reach levels that could cause irritation of the eyes and respiratory tract of persons exposed. H_2S concentrations would remain far below the 500 ppm levels that would be life-threatening.

Mitigation:

Emergency shutdown of all wells would occur when the pressure drop cause by the rupture is sensed.

Impact: Accidental release of the isobutane working fluid would present potentially hazardous conditions. Isobutane is normally stored as a colorless, odorless, and flammable compressed gas. If it were accidentally released during low wind conditions, it would form a visible vapor cloud at ground level. The vapor would irritate the eyes and, if inhaled, could cause dizziness, breathing difficulties, and loss of consciousness. In concentrations from 1.8% to 8.4% with air, the cloud could be ignited.

TABLE 4-9: MAXIMUM GROUND-LEVEL H_2S CONCENTRATIONS AFTER A FIVE-MINUTE RELEASE OF GEOTHERMAL FLUID AT 5,000 GPM

Stability Class	Wind Speed (mph)	Distance From Source (feet)	Maximum H_2S Cencentration (ppm)
A	1.1	69	54
B	1.1	89	59
C	15.7	46	50
D	11.2	53	83
E	4.5	797	7
F	2.2	1,004	10

SOURCE: Environmental Science Associates, Inc.

A Gaussian "Puff" model (Turner, 1970; Dobbins, 1979) was used to estimate ground-level concentrations from a short-duration catastrophic release of 20,000 gallons of isobutane from the facility. This model is based on Gaussian (normal statistical) distributions of pollutant concentrations in the downwind, crosswind, and vertical directions relative to the source. The model does not account for the effects of terrain or other obstructions to flow nor are they applicable to estimates of concentrations at specific points. Models of this type typically underestimate horizontal spread and overestimate the vertical spread of dense pollutant clouds (Van Ulden, 1974; Connell and Church, 1978). This is an important consideration because isobutane is a dense gas at ambient temperatures and pressures and will not disperse according to strict Gaussian equations. Model results, therefore, provide order-of-magnitude estimates of worst-case ground-level concentrations and must be interpreted carefully. Model input parameters are listed in Table 4-10 with the values used for this analysis. Model results, shown in Table 4-11, indicate that ground-level concentrations immediately down-wind of the source could reach concentrations of 8 % of air by volume. This is within the range of flammability. Although model results indicate a rapid decrease of concentrations away from the plume centerline, because isobutane is a heavy gas, it is likely that concentrations away from the centerline would be higher than those shown in Table 4-11 due to the lack of vertical and horizontal Gaussian dispersion.

TABLE 4-10: PUFF MODEL INPUT PARAMETERS AND ASSIGNED VALUES

Input Parameter	Value
Total mass of pollutant /a/	20,000 gallons = 1.74 x 10^6 g (at a density of 1.44 lbs/ft^3).
Sigma x,y,z (downwind, crosswind and vertical dispersion parameters respectively) /b/	Sigma x = 4 Sigma y = 4 Sigma z = 3.8
Downwind distance to receptor (m) /c/	100
Crosswind distance to receptor (m) /d/	1, 10, and 20 meters
Ambient windspeed (m/s)	2.24
Time in seconds for plume to reach receptor /e/	45
Effective height of emission /f/	30 feet

/a/ Total pollutant mass is based on an estimate of the density of isobutane as a saturated vapor at 280°F (the reported temperature of gases upon release). (The density at 280°F was obtained by linear regression with a regression coefficient of 0.992).
/b/ Dispersion coefficients are from Turner (1970) for neutral atmospheric conditions.
/c/ Distance to the downwind receptor is limited to the value with which dispersion parameter values were derived by Turner (1970).
/d/ Crosswind dispersion is assumed to be equal to downwind dispersion.
/e/ The time it takes the plume to travel 100 meters at 2.24 m/s.
/f/ Height of a turbine exhaust, the largest diameter opening through which isobutane could escape.

SOURCE: Environmental Science Associates, Inc.

Mitigations Proposed as Part of the Project:

- The air-cooled condenser fan drafts would dilute and disperse any leaked vapors. Hydrocarbon sensors and alarms would alert personnel of the event. Vacuum trucks would collect the vapor for potential reuse.

TABLE 4-11: PUFF MODEL RESULTS FOR CATASTROPHIC RELEASE OF ISOBUTANE

Crosswind Distance (m)	Concentration (ppm)	Percentage in Air by Volume
1	8.9×10^4	8.9
10	4.6×10^3	.5
20	4.2×10^{-1}	negligible

SOURCE: Environmental Science Associates, Inc.

- If the cloud were to ignite, standard procedures would call for the material to be burned off. Relief valves and discharge valves would be opened to reduce the quantity of material available for combustion.

Mitigations Proposed in this Report:

- An appropriate level of odorizer (mercaptan) should be maintained in the isobutane system at all times to assist in leak detection.

4.1.2 BIOLOGICAL ENVIRONMENT

4.1.2.1 Vegetation

Impacts: A loss of up to 26 acres of sagebrush scrub, Jeffrey pine, Jeffrey pine/pinon pine, and rhyolite buckwheat scrub plant communities would occur from construction of the MP II & III plants, well fields, and pipelines. Based on site maps prepared by the proponent and vegetation maps prepared by Taylor and Buckberg (1987), it is estimated that less than 13 acres of Jeffrey pine, less than seven acres of sagebrush scrub, and about 1.25 acres each of Jeffrey pine/pinon pine and pinon/juniper woodland would be directly impacted. Less than one acre of rhyolite buckwheat scrub, a botanically sensitive plant community, would be impacted. These potential losses are detailed by ownership in Table 4-12. About three acres of the proposed power plant site is already a disturbed ruderal area.

TABLE 4-12: ESTIMATED ACRES OF HABITAT LOSS BY LAND OWNERSHIP

	Jeffrey Pine	Sagebrush Scrub	Jeffrey Pine/ Pinon Pine	Pinon/Juniper Woodland	Rhyolite Buckwheat Scrub
USFS	9.00	2.00	0.00	0.00	0.00
Private	3.50	4.75	1.25	1.25	0.75
TOTAL	12.50	6.75	1.25	1.25	0.75

SOURCE: Environmental Science Associates, Inc.

Mitigation:

- During construction and operation of the facilities, care should be taken to avoid damaging existing vegetation whenever possible. The large areas which are already disturbed should be utilized for laydown, storage, and construction activities.

- Revegetate all disturbed areas, including those which were damaged during earlier activities. Plant Jeffrey pine seedlings near the plant site and shrubs elsewhere as soon after construction as possible. Seedlings of big sagebrush, Artemesia tridentata, fourwing saltbush, Atriplex canescens; rabbit brush, Chrysothamnus nauseosus; and antelope bitterbrush, Purshia tridentata should be used. Preferably seedings which have been grown locally from locally gathered seed should be used; this will help maximize success of the revegetation (Racin and Dayak, 1986). Plantings should use a mixture of sand and loam to aid in soil binding and to prevent seedling collapse (Racin and Dayak, 1986). Preplanting irrigation should be done to prevent wick drying of seedlings. Seedlings must be protected from grazing animals either by fencing or wire cages to help insure survival (Racin and Dayak, 1986). Plant spacing should be approximately two feet to allow working room without damaging seedlings. (If locally grown seedlings are not available, they can be grown to order by CRP Nursery in Windsor, California and Tree of Life Nursery in San Juan Capistrano, California. Several month's notice is required.)

- Seedling survival should be monitored. If after three years, less than 50% of seedlings have survived then replacement planting should be conducted. Survival of shrub seedlings was studied at a site in eastern California similar to the project site. The survival rate after one year for Artemesia tridenta and Atriplex canescens was 94%. For Chrysothamnus nauseosus the survival rate was 88%. Fifty-eight percent of the Purshia tridentata survived one year. Mortality was caused by transplant shock, lack of water from drying winds, extreme temperatures, and burrowing animals (Racin and Dayak, 1986).

- Use drip irrigation of trees and shrubs until they are sufficiently tall to screen facilities (Novak, 1986). Without irrigation, seedlings of Jeffrey pine could be expected to reach between five and eight feet in height after ten years with diameter-breast-height (dbh) of 0.6 to 2.2 inches. After 20 years, the heights would range from 13 to 26 feet with dbh 3.8 to 6.6 inches (Oliver and Powers, 1978). It is likely that the trees would be at the large end of the size ranges if they were irrigated.

Impact: Pipeline construction may impact botanically sensitive areas near the proposed plant. Construction of the proposed pipeline connecting wells MPI 42-32, MPI 42A-32, MPI 42B-32, MPI 42C-32, MPI 52-32, and MPI 52A-32 with the power plants may impact botanically sensitive areas. The pipeline from wells MP 12-32 and MP 12A-32 may pass through a botanically sensitive area. The botanically sensitive areas are all on private land (see Figure 3-5).

Mitigation:

- Pipelines and new access roads should be sited so that construction activities avoid the sensitive areas. This may require adjustments of well locations. Refer to the site plan in Figure 2-2 for the presently planned locations of wells. During the siting phase, a botanist should ground-truth the locations of the wells and pipelines to ensure that they will not impinge on the botanically sensitive areas. The following changes are recommended:

  - U.S. Forest Service Land: No changes are recommended for wells or pipelines on USFS land.

- o Private Land: Move injection well MPI 52-32 approximately 100 feet north of its proposed location. Move the pipeline from wells MP 12-32 and MP 12A-32 approximately 50 feet north to avoid the botanically sensitive area to the west of the proposed power plant sites.

- Prior to construction, botanically sensitive areas should be fenced to prevent encroachment by construction vehicles and equipment. Simple single-strand wire fence with colored surveyor's flagging should be sufficient to prevent entry by vehicles. Vehicles should be restricted to existing roads.

4.1.2.2 Terrestrial Wildlife

Impact: A loss of up to 18 acres of sagebrush scrub and Jeffrey pine wildlife habitats is expected from construction of the power plant. These are widespread habitats in the area and there would be no significant impacts to populations of species using these habitats. Populations of pygmy nuthatches and hairy woodpeckers are not expected to be impacted, as less than eight acres of Jeffrey pine habitat would be lost. The pine stands, because they are young and have few snags, are of moderate value for these species. The pine stands provide feeding habitat, but no valuable nesting habitat. No impacts to sage grouse populations are expected, as the area receives little sagegrouse use and there are no nearby leks. No endangered, threatened or other special status animal species are known to use the site. Thus no impacts to these species are expected.

Mitigation:

- None is necessary.

Impacts: Noise and human activity may reduce songbird density near the power plants and may cause migratory deer to avoid the area. The impact on pygmy nutchatch and hairy woodpecker populations is not expected to be significant (PG&E, 1986).

Mitigation:

- Minimize noise generated by construction and operation of the plant (see Section 4.1.1.3). This may serve to reduce impacts on wildlife, but the correlation between songbird density and noise levels has not been unequivocally demonstrated, so a definite result cannot be predicted. Similarly, it is unclear to what extent deer are affected and no specific result can be anticipated with respect to deer populations and noise levels (PG&E, 1986).

Impacts: Fifty to 100 migratory deer from the Buttermilk, Sherwin Grade, and Casa Diablo Herds would be impacted by construction and operation of the power plant and associated pipelines. The plant and pipelines may directly impede deer movements through the area and pipeline configuration may funnel deer into impassable areas. These impacts would occur from development of either the proposed or alternate power plant locations. Migration routes in the site area are not well defined. Deer have been found to move across a broad area in this flat terrain in contrast to the narrow, constrained corridors of the Sierran escarpment (Kucera, 1987b).

Migratory deer may be impacted by construction and operation of the power plant and associated pipelines. The plant and pipelines may directly impede deer movements through the area and pipeline configuration may funnel deer into impassable areas.

Mitigation:

- Design pipelines and fencing to avoid a funneling effect. Either bury short segments of pipelines as crossings or build crossing ramps to allow deer passage. Crossing points should be no farther than one-eighth mile (660 feet) apart. Crossings or crossing ramps should be at least 10 feet wide and at a gently sloping angle. These measures should insure adequate crossing opportunities for migratory deer.

- If necessary, consider the appropriation of funds toward the purchase of federal land in the Swall Meadow area for winter range habitat.

4.1.2.3 <u>Aquatic Resources</u>

4.1.2.3.1 Construction Activities

<u>Impact</u>: Increased sedimentation in Mammoth/Hot Creek may result from grading of new roads and building surfaces. Elevated turbidity levels would clog and irritate gill structures and impair respiration, feeding, and swimming capabilities of resident fish and aquatic invertebrates.

<u>Mitigation</u>:

- See Section 4.1.1.1 for a discussion of the measures to control erosion and sedimentation.

<u>Impact</u>: Organic compounds which would be used during drilling and construction could spill and contaminate local waters. Paint, diesel fuel, lubricating oils, and small quantities of solvents would be stored and used on-site. These compounds are toxic in low concentrations and would cause adverse effects to aquatic resources if any leakages or spills occur into project waters.

<u>Mitigation</u>:

- All paints, fuels, lubricants, solvents, or other compounds potentially harmful to aquatic organisms should be stored in secure containers within the bermed areas so that leaks would be contained. Permit requirements of the Lahontan RWQCB should suffice to mitigate this potential impact.

4.1.2.3.2 Long-Term Activities

Operation of the plant would require pumping from the geothermal reservoir. As discussed in Section 4.1.1.2.3, Water Quality and Hydrology, there is no consensus on how subsurface thermal resources move within the Long Valley caldera so it is not possible to make a definitive statement about how operation of the plant would affect the springs which supply Hot Creek Hatchery. Section 4.1.1.2.3 discusses the impacts of the project on water quality and hydrology. In that section two possible effects are identified. The first would be thermal contamination of surface water due to the rupture of lines feeding geothermal fluid to a power plant. The second, which is not predicted based on modelling of the system as it is now understood, is a decrease in either the volume or temperature of the water in the reservoir beneath Hot Creek Hatchery or Hot Creek Gorge. The following discussion is based on the assumption that adverse effects would occur. In fact, it is the intent of the monitoring program to identify adverse impacts based on observations made at the established monitoring points and to allow implemention of appropriate mitigation measures before the Hot Creek Hatchery or Mammoth/Hot Creek fishery is adversely affected.

Impact: If the production pipelines feeding a plant rupture, pressure would suddenly drop and the wells would be shutdown automatically. Assuming the worst-case scenario that the full production of 5,000 gpm of superheated geothermal fluid from one plant is released for five minutes, there would be a flow of approximately 10 cfs of 200°F fluid released for the five minute period. (This assumes that approximately 15% of the fluid would flash to steam as the pressure drops to atmospheric.) If none of the released fluid infiltrates, it would flow in the intermittent streambed into Mammoth Creek. Even if the heat losses from evaporative cooling, heating of the stream bed, and mixing with flow, if any, in the intermittent stream cause the temperature to drop significantly below 200°F, there would be a slug of relatively high temperature water reaching Mammoth Creek. Based on current knowledge of trout physiology, rainbow trout will survive temperatures of 32°F to 82°F, with optimum temperature for growth and completion of most life history stages at 55°F to 70°F (Moyle, 1976). Temperatures of 45°F to 66°F are optimum for rapid growth of brown trout, with preference for temperatures at the upper end of this range. Brown trout are able to withstand short exposures to temperatures in excess of 81°F. If the slug of geothermal fluid raises the stream temperature to near or above the upper temperature limits of these fishes, mortality would occur. The extent and severity of the fish kill would depend on the time of year and the condition of the fish at the time of the spill.

Mitigation:

- Reduce the maximum flow of geothermal fluid which could reach Mammoth Creek, so that the volume of hot geothermal fluid reaching Mammoth Creek would be sufficiently small that it would not adversely affect the Mammoth/Hot Creek fishery.

Impact: The operations of the Hot Creek Hatchery are dependent on the constant temperature and reliable flows of the several springs which supply the facility. Depending on their location on the hatchery site, individual springs vary annually in temperature from approximately 53°F to 63°F, with the mean temperature of all springs being approximately 58°F. The set of upper springs, AB springs (60°F ± 2°F) to the north and CD springs (57°F ± 2°F) to the south, feed the production, or rearing, ponds and maintain these temperatures throughout the year (Eichmann, 1987b). These ponds would not be as sensitive to slight temperature variations as the broodstock facilities. A decrease of greater than two degrees from the present temperature regime would slow fish growth and result in higher costs to the hatchery program because of the additional feed needed and the larger number of ponds and water which would be required to hold the fish for a longer period of time until they reached suitable planting size (Eichmann, 1987c).

Smaller springs at the lower (east) end of the hatchery grounds, probably the most critical to the hatchery program, supply the broodstock facilities. The springs feeding the Hatchery 1 broodstock pond complex are at a temperature of approximately 54°F ± 1°F throughout the year. At the Hatchery 2-3 broodstock pond complex, yearly temperatures average 52°F ± 1°F. Within these two complexes, up to seven strains of wild and domestic cutthroat, rainbow, brook, and golden trout are spawned on a staggered schedule throughout the year. The Coleman strain of rainbow trout is of particular importance because it spawns after the Hot Creek strain (e.g., November through January versus July through September) and before trout raised at other facilities, thus enabling the hatchery to plant trout year-round. In order to produce good quality eggs, the rainbow trout must be held for at least six months before spawning in waters not exceeding 56°F, but preferably not above 54°F. A temperature increase of one degree may result in a 5% to 15% decrease in fertility whereas a 2°F increase would kill virtually all the eggs and severely impact the hatchery operation (Eichmann, 1987b). A reduction of 2°F in the present temperature range would delay spawning until spring due to the increased time period necessary for egg maturation. This would for all practical purposes eliminate the Coleman and Hot Creek strains and severely impact the hatchery's statewide trout planting program.

If production of geothermal fluid at the project does, contrary to the predicted results, cause a decrease in the temperature or amount of thermal water reaching Hot Creek Hatchery, its operations would be adversely affected.

Mitigation:

- Supply the necessary thermal water by drilling wells to tap the geothermal reservoir or heat the water to the proper temperature using another source of energy. Using geothermal water would further deplete the geothermal reservoir and would require an investment in equipment to achieve the appropriate mix of pumped and spring water. Heating water probably would be prohibitively expensive (see Economics, Section 4.1.3.2) and is not a feasible mitigation for the loss of thermal water to Hot Creek Hatchery.

Impact: The endangered Owens Tui Chub is known to exist in pools near the headwaters of Hot Creek. Sediment leaving the project area could not affect these pools because they are located above the Hot Creek/Mammoth Creek confluence. Similarly, a spill of geothermal fluid would not affect the Owens Tui Chub. The hydrology report has stated that geothermal development at Casa Diablo will not affect shallow ground water near Hot Creek and therefore should not affect these fish. If there are unknown refugia occupied by the Owens Tui Chub within the area affected by runoff from the project, the project could adversely affect fish using those refugia.

Mitigation:

- A survey of waters within the project area is being undertaken to confirm the presence/absence of the endangered Owens Tui Chub. If any of these fish are found during the survey, they will be protected pursuant to stipulations rendered by a biological opinion to be prepared by the U.S. Fish and Wildlife Service as specified by Section 7 of the Endangered Species Act.

4.1.3 SOCIAL ENVIRONMENT

4.1.3.1 Visual Resources

Impacts: Drilling rigs and accessory equipment would be strong, but temporary, visual elements of the landscape because of their form, size, strong vertical lines, and strong contrasting colors. Once the wells were completed, the wells would be capped and the drilling equipment would be removed, eliminating any substantial structures from the well sites.

Mitigation:

- None is necessary.

Impacts: Well pads, wellhead equipment, pipelines, and access roads would become long-term features of the landscape. Grading for well pads and access roads would alter the natural form of the landscape slightly. The smooth, horizontal lines of the roads, transmission lines, and pad surfaces would contrast with the existing slopes and ridges, which are undulating and irregular, without sharp lines or divisions. These project elements would differ also in texture from existing natural surface features. The road and well pad surfaces could contrast in color with existing vegetation and surface soils.

Once the drilling rigs and associated equipment were removed from the well sites, the well pads, wellhead equipment, fluid transmission lines, and access roads could be visible to northbound traffic from Highway 395 from about one mile southeast of the Casa Diablo area to about one-half mile south of the Casa Diablo area and from State Route 203 east of Highway 395. The degree of visibility from these viewpoints and the degree of contrast probably would be moderate, however, depending upon the exact placement of well pads, alignment of access roads, and extent of revegetation and screening. With appropriate mitigation for visual effects, the overall visual impact would be slight to moderate.

The power plant would be the most visible element of the project, visible from State Route 203 east of Highway 395; from northbound Highway 395 for a distance of about one mile beginning at a point near the west end of the airport four miles from the plant site; and again from northbound Highway 395 from about one mile southeast of Casa Diablo to one-half mile south of Casa Diablo; from a short segment of State Route 203 about one mile west of the plant site; and from portions of Sawmill Road about 1.5 miles west of the plant site. The viewpoint from which the most viewers see the site is on Highway 395 near the meadow containing Mammoth Creek. The generator and condensers, at heights of about 30 feet above grade, would stand out because of the lack of topographic or vegetative screening in the foreground, as described in the Setting. At night, work lights and structural lighting of the power plant would be clearly visible. The views of the power plant and accessory structures would create the impression of industrial activity which would contrast with the generally natural character of the surrounding landscape. Figure 4-2 is a photomontage of the proposed plant in the existing setting as seen from State Route 203 just east of Highway 395.

The project would be clearly visible to motorists on Highway 395 and is therefore in conflict with the Visual Management Objective (VMO) of "Retention" which has been established by the USFS for the project area.

Mitigations:

- Lay out well pads and roads so that mature trees are preserved.

- Disturbed soil areas should be partially or completely revegetated as soon as practical once construction and site development are completed.

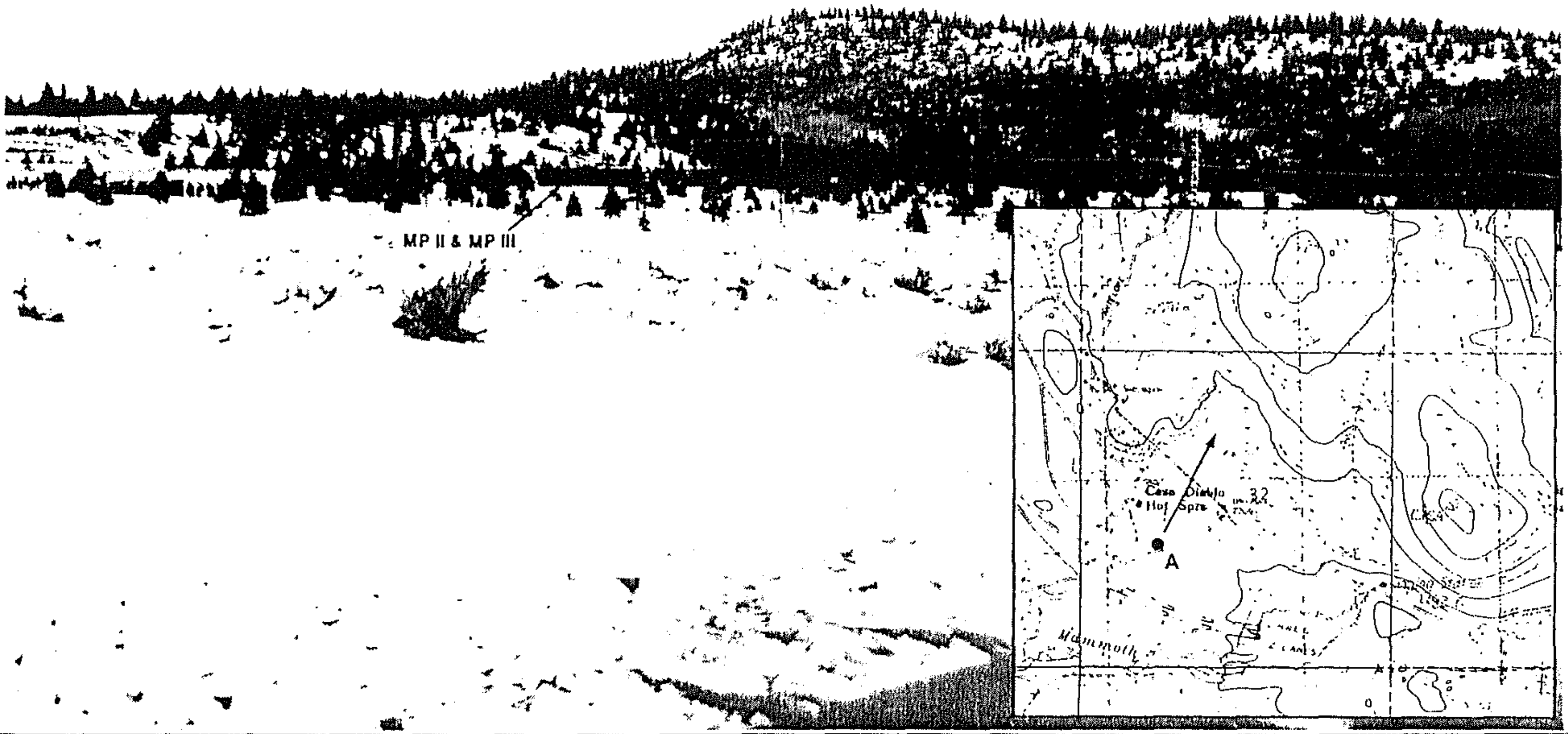
- Native trees and shrubs should be planted on the project site to screen equipment yards and accessory structures, and the lower portions of the major structures on the site. Screening by trees and shrubs would be increasingly effective as the vegetation grew taller. This concentration of vegetation would appear somewhat un-natural to most viewers, but would result in less impact than exposed views of the power plant site. See Section 4.1.2.1, Vegetation, for of discussion of revegetation.

- Exteriors of structures, including pipelines and their supports, should be a neutral earth-tone color.

- To the extent compatible with engineering considerations, all exterior surfaces should be a rough texture, with no reflective metal or glass surfaces oriented toward the south or west.

- Insert redwood laths in all chain link fencing.

- Exterior structural lighting should be minimized; where exterior lighting is necessary, diffuse lighting systems should be kept under about five-foot candles. Work lights should be switched or equipped with timers, rather than being designed for continuous use, and workers should be encouraged to minimize the use of night lighting.



SOURCE: Environmental Science Associates

FIGURE: 4-2

Photomontage of Project in Existing Setting

- Apply the above mitigation measure to the MP I plant.

- Locate the plant 400 to 500 feet east of the proposed plant site to take advantage of the screening which would be provided by the mature treees.

Other mitigations would serve to make the plant less conspicuous, especially placing the plant in the alternate location.

Even with mitigations, the plant would be noticed by casual observers and the project would therefore be inconsistent with the VMO of "Retention".

4.1.3.2 Socioeconomics

4.1.3.2.1 Land Use and Planning

Impact: The proposed construction of MP II & III project would intensify the industrial activity at the site. The most noticeable impacts would be concentrated on site, in the form of disrupting the open space and grazing land uses of the presently undisturbed parts at the site. Soil would be disturbed as the plant site and well pads were being cleared and prepared for construction. Areas northeast of the plant site would also be cleared and graded for new access roads serving the injection wells. The use is compatible with current County and USFS plans, with the exception of the visual management policies discussed above.

Mitigation:

- See Section 4.1.1.1, Soils and Erosion, Section 4.1.2.1, Vegetation, Section 4.1.3.1, Visual Resources, Section 4.1.3.5, Range, and Section 4.1.3.4, Timber.

4.1.3.2.2 Employment, Population and Housing

Impact: The type and amount of employment generated by the MP II & III power plants would differ between the construction and operation phases. Based on the work force used during the construction of the existing MP I facility, the construction phase employment for each plant is expected to fluctuate with the stage of power plant construction and well drilling, averaging 48 workers over a nine-month period, and peaking with 82 workers in the fifth month during the summer when weather conditions are most favorable for construction work. The construction of the two plants would not occur simultaneously. During the operational phase MP II & III would utilize the existing MP I managerial, clerical, and maintenance staff. The only new personnel required during commercial production would be two plant operators per shift, or six new operators total (three shifts per day), for each new unit. The impact upon the local labor force would vary depending on whether the employees are hired locally or brought in from outside the area.

Three employment scenarios are considered and presented in Table 4-13:

- Minimum local employment (0%) -- entire labor force non-local;
- Mid-range local employment increase (44%) -- only entry level jobs filled by local labor force (Asper, 1987b); and
- Maximum local employment increase (69%) -- labor force employment pattern similar to pattern found at the MP I geothermal plant (Asper, 1987b).

TABLE 4-13: LOCAL EMPLOYMENT

Single Geothermal Plant	Average Construction	Peak Construction	Two-Plants Operational
Minimum	0	0	0
Mid-range	21	36	5
Maximum	33	56	8

SOURCE: Environmental Science Associates, Inc.

Since some employment would go to people presently living outside of the area, an increase in the local population would result. The size of the increase would depend on the portion of employment that would go to people living outside of the local area, the labor pattern of households, and household size.

For this analysis, it has been assumed that each non-local employee will have an average household size of 2.33 (California Department of Finance, 1987). This number is likely to be smaller for temporary construction workers. Using the three employment scenarios, the expected population increase is shown in Table 4-14.

TABLE 4-14: POPULATION INCREASES

Single Geothermal Plant	Average Construction	Peak Construction	Operational
Minimum Local Employment	108	191	28
Mid-range Local Employment	63	126	16
Maximum Local Employment	42	61	9

SOURCE: Environmental Science Associates, Inc.

Since a portion of employment would go to people presently living outside of the area, a demand for housing would result. Most construction employees may be expected to seek temporary housing; the operating employees would seek permanent housing. Experience during the construction of the MP I geothermal plant indicated no problem with housing the construction workforce. In large measure, this was due to the fact that the greatest population increase would coincide with the off-peak season, lessening the impact. Using the maximum population increase scenario, the demand for permanent residential housing would be expected to increase by less than 0.3%. Given the almost two-year-long construction period for both plants, construction of some additional housing can be expected.

Mitigation:

- The percentage of the local labor force employed may be increased through the use of "first source" hiring.

- Construction activity should be timed so that peak construction housing needs do not coincide with the peak tourist housing demand.

4.1.3.2.3 Economics

Impacts: The local economy would benefit temporarily from the increased retail demand and demand for housing during the peak construction phase. Employment in the construction sector would also benefit. The local economy would experience a longer lasting but lower level benefit during the operational phase from retail purchases made by the plant and by plant employees, and from the availability of local entry level jobs. The direct payroll is expected to be similar to the payroll at the MP I 10 MW geothermal plant which totaled $451,000 in 1986. The annual payroll for 12 plant operators may be expected to average $300,000. Local trade with Inyo/Mono County merchants from MP I totaled $159,000 in 1986 (Asper, 1987b). Due to the unified nature of the expanded facility (e.g., shared control room and on-site substation) the increase in local trade would be somewhat less than $300,000. The year-round operation of the plant would help stabilize the highly seasonal nature of employment and retail sales.

Mitigation:

- None is necessary.

Impact: The possibility of negative local economic impacts is largely associated with the unlikely but possible depletion of geothermal water at Hot Creek Gorge and the Hot Creek Hatchery. Such a loss would reduce employment, retail sales, and rentals based on servicing trout fishing and hot spring bathing, increasing the severity of the unbalanced winter/summer tourist economy (Hawley, 1987).

The unique nature of the Hot Creek Hatchery and its fall spawning strain of rainbow trout make it impossible to estimate the true economic value of their loss. The immediate loss in terms of the "dollar value" of the recreational days provided by fish and eggs from the Hot Creek Hatchery was estimated in 1976 to approximate $9,500,000 annually (Fullerton, 1976). Adjusted for inflation using the consumer price index for California produced by the U.S. Department of Labor, Bureau of Labor Statistics, the "dollar value" today would equal over $19,000,000 annually.

Mitigation:

- None is necessary.

Impacts: Many of the costs incurred by the county in relation to the geothermal plant would be paid for by fees (e.g., processing permits, recording documents). Various departments would incur costs not covered by applicant fees (e.g., Board of Supervisors, Sheriff, County Counsel). The greatest demand for increased general county services and fiscal expenditures would be associated with the increase in residential population. Mono County's experience with geothermal projects has not yet developed to the point where it can be determined precisely what costs are associated with such a development. County costs would also depend on the types of mitigation measures implemented.

Mitigation:

- Application fees should be adjusted to ensure that the fees charged actually cover costs. Services which could be provided on a fee basis may be changed to such a basis.

- The County could assess impact fees, user fees, and conduct maintenance agreements to assure the costs need not be financed out of the general fund.

- The greatest mitigation of community service costs would be the increasing of local hiring.

4.1.3.2.4 Community Services

Schools

Impacts: The impact on school facilities is tied directly to increased school enrollment. School enrollment in turn will be dependent upon the demographic characteristics of the families of the non-local labor force. To estimate enrollment impacts, the Mammoth School District uses a student generation factor of one student per 7.67 persons of permanent population (Martin, 1987). With an average household size of 2.33 persons and actually be built and not all are appropriate for discussion in this document, so in consultation with the Energy Management Department and the BLM, the list shown below in Table 5-1 has been used as a basis for discussion. Because the geographic area appropriate for discussion varies with the resource under discussion, not all the projects are included in each discussion. The table summarizes which projects were considered for each topic. The locations of the projects are shown in Figure 5-1.

TABLE 5-1: MAMMOTH LAKES AREA PROPOSED PROJECTS CONSIDERED IN THE CUMULATIVE ANALYSES

	MP II & III	PLES I	Mammoth/ Chance I and II	Doe Ridge	Snow Creek	Sherwin Bowl	Juniper Ridge
Geology, Geologic Hazards, Soil	X	X	X				
Water Quality and Hydrology	X	X	X	X			
Noise	X	X					
Air Quality	X	X	X				
Biological Resources	X	X	X	X	X	X	X
Visual Resources	X	X					
Socioeconomics	X	X					
Recreation	X	X	X	X			
Timber	X	X					
Range	X	X					
Cultural Resources	X	X	X				
Transportation and Access	X	X					

SOURCE: Environmental Science Associates, Inc.

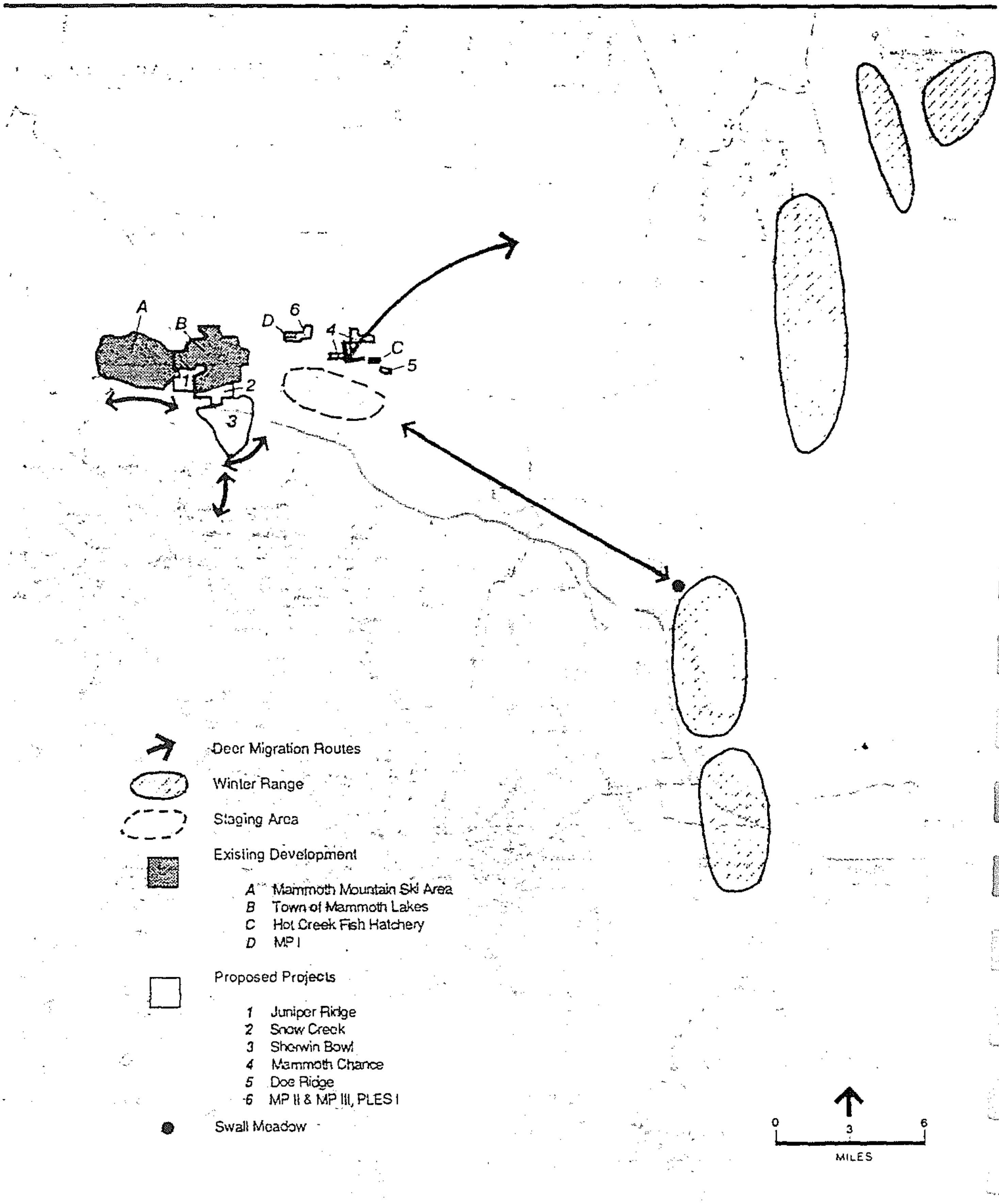


FIGURE: 5-1
Regional Map for Cumulative Analyses

Mitigations Included as Part of the Proposed Project:

- Standard first aid supplies would be available throughout all phases of field development, site construction and power plant operations.

- Personnel would be instructed where both the first aid supplies and emergency control services and emergency action notification lists are located.

- All proposed on-site and off-site drilling, construction, and production activities would be conducted in compliance with applicable safety regulations as administered by the California Department of Industrial Relations, Division of Occupational Safety and Health (Cal/OSHA). Wells would be drilled and completed in conformance with the requirements of the U.S. Bureau of Land Management.

- Surface pipelines would be covered with an insulation wrapping which will prevent burns from accidental contact with the geothermal pipelines.

Mitigation Recommended in this Report:

- The County emergency response plan should be revised to incorporate geothermal development emergency needs.

- On-site personnel should be trained in first-aid and CPR.

- Communication and evacuation procedures in the event of severe burn accidents should be developed and maintained.

Fire Protection

Impacts: The construction and operational phases present different concerns for the Long Valley Fire Protection District. The major concern during the construction phase is the potential for forest or brush fires, especially during the end of the dry summer season. During the operational phase, isobutane is used as the binary working fluid. It is a very flammable substance used and stored on-site, so the possibility of an accident or an equipment failure and the release of the isobutane to the atmosphere is a major concern.

In such an event the isobutane could form a cloud at ground level which might be ignited. The spreading of a fire during the seven to 15-minute response/access time is a serious problem.

Were the fire to spread beyond the immediate area, safety concerns would focus on three areas: 1) traffic on the adjacent Highway 395; 2) the three 10,000 gallon gasoline storage tank owned by Chevron, located one-quarter mile southeast of State Route 203 and one-eighth mile north of Highway 395; and 3) the 100,000 to 150,000 gallons of propane stored in six tanks owned by Cal-Gas, Petro-Lane and Turner, located about one mile from the site (Malby, 1987).

Mitigations Proposed as Part of the Project:

- During the construction phase all safety regulations would be followed and portable fire-fighting equipment capable of extinguishing small grass or paper fires would be maintained on site.

- The power plant would be designed in accordance with applicable Codes (e.g., 1976 and 1982 Uniform Fire Codes) and sound engineering practice, thus ensuring that during normal operation there would be no evolution of working fluid to the atmosphere other than from minor fugitive sources.

- The air cooler draft fan would be situated in such a way that it can be expected to dilute any working fluid leakage and harmlessly discharge it to the air. As an additional safety measure, a berm would be erected on all four sides of the plant site to prevent any leakage from migrating beyond the plant boundary.

- In the event a working fluid leak is ignited, the equipment containing the working fluid would be protected from overheating and fire damage by a fire resistant insulation or cement. Such equipment includes the working fluid accumulato. vessel, the working fluid to brine exchangers and the working fluid circulating pump suction lines. The working fluid air coolers would be located on top of a steel supporting structure some 20 feet above ground. The structural steel columns and beams would be fireproofed against fire damage for two hours. This is the standard petroleum refining practice where flammable liquids are handled.

- It is also standard practice to let a liquefied petroleum gas fire burn rather than to attempt to extinguish the fire. Isolation valves and drain piping are sometimes used to drain tanks, exchangers, etc., so that the burning time may be reduced. Where practical, this practice would be followed. Relief valves which discharge through pipes to a safe elevation would protect equipment from exceeding design pressures.

- Fire control equipment would include: 1) Water storage tank (estimated 500,000 gallons); 2) fire pump and accessories, including: electric fire pump with batteries and charger, diesel fire pump with diesel fuel system, jockey pump controllers; 3) fire protection apparatus including: fire hydrants, monitors, and valves; fire hoses; automatic sprinkler for the control building; fire line pipes and fittings; and 4) fire alarm system, including control panel, gas (isobutane or isopentane) detectors ultraviolet flame detectors, and ionization detectors.

- Portable fire extinguishers would be installed throughout the plant area and in buildings for use on small grass or paper or refuse fires or smoldering situations as may arise. Standard first aid equipment would be on hand for any burn victims.

<u>Mitigations Recommended by the Long Valley Fire Protection District</u>:

- Prior to the issuance of a use permit, a detailed fire prevention and protection plan should be submitted and subjected to review and consideration by the Long Valley Fire Protection District and the Mammoth Lakes Fire Department. In addition to the fire protection system, this plan should address: automatic plant shutdown; communication protocol with fire officials; emergency access/egress procedures for the facilities, including roadway access maps for fire crews; discouragement of smoking except in designated, specially prepared areas; maintenance of a checklist of manpower and fire-fighting equipment, including off-site water sources, that are available in the event of a fire; maintenance of all access routes and work sites free of vegetation and flammable material; and compliance with the 1982 Uniform Fire Code.

- In addition to the on-site fire protection equipment, a program of mitigation fees or equipment donations is in place for new construction. The fees are charged on a square footage basis ($.30 a square foot). The program is being revised to incorporate a separate fee system for geothermal plants based either on their megawatt capacity or on the amount of flammable working fluid on site. The mitigation fee is expected to range from $30,000 to $40,000 per 10 MW plant (Malby, 1987). Partial funding for an additional Long Valley Fire District fire station closer to the project may be available through a state geothermal grant due to the specific nature of the geothermal plant's working fluid. Such a grant would take the form of a matching grant dependent upon mitigation fees raised from the developer (Malby, 1987).

Street and Road Maintenance

Impact: Heavy loads would be transported over county and USFS roads during each nine-month construction period. This may result in the need for additional repair and increased maintenance. The volume of traffic generated by the operational work force is not expected to significantly increase the local traffic level of the roadway.

Mitigation:

- To recover the costs of repair, the county may consider entering into agreements with the developers for the repair of any damage caused by project activities to the road system. The cost of maintaining public (county or USFS) road used to access the site can be transferred to the applicant by the use of such funding mechanisms as formalized maintenance agreements for maintenance and the repair of any damage to the road system caused by geothermal traffic, conditional road use permits, and the posting of performance bonds. Alternatively, a user fee based on weight and frequency of use could be imposed.

Impacts: Because air-cooled condensers would be employed instead of water-cooled towers, the potential problems of road icing and induced fog clouds from cooling tower fluids would not present a problem. A slight potential for road icing and induced fog clouds would exist during flow testing.

Mitigation:

- Conduct flow tests under atmospheric conditions that would minimize induced icing and fog clouds.

Wastewater

Impacts: Water and sanitary facilities would be required during construction operations. The expected water requirement for the facilities, based on an estimated manpower requirement of 12 people, would be 225 gallons per day. This would also entail the generation of sanitary wastes. There would be no consumptive water use for power plant cooling as air cooling would be used.

Mitigations Proposed as Part of the Project:

- Bottled water would be furnished for drinking during construction and production operations.

- During the construction phase, portable chemical toilets would be utilized.

- A water and permanent septic tank and leach line sewage disposal system would be constructed at the site to for the use of the permanent work force. As there are no shallow water wells in the vicinity of the proposed power plant site and the project site is outside of the water service area of the Town of Mammoth Lakes, a water storage tank would be constructed to store water delivered to the site from either the existing MP I groundwater well or from a reverse osmosis treatment unit which could be constructed on-site to treat cooled geothermal fluid. The water storage tank would also serve as an emergency water source for safety showers and fire-fighting purposes. The water tank volume is estimated at 50,000 to 500,000 gallon capacity. Final tank volume would be determined during the engineering design of the facilities. All waste disposal programs would be subject to agency approval prior to the implementation and would be operated in accordance with applicable federal, state, and local requirements.

Solid Waste

Impacts: Solid wastes would be generated through the drilling of the geothermal wells and during the construction operations. Both are expected to be non-toxic. Because solid waste disposal would be provided by private companies, these services would not impact the county provision of services. Construction wastes composed of inert solids (Group 3 wastes) and organic solids (Group 2 wastes) may be collected and transported to the Class II landfill at Benton Crossing with no adverse effects. The increase in residential wastes associated with the increase in residential population is not expected to significantly affect the lifespan of the Benton Crossing landfill.

Mitigation:

- None is necessary.

Utilities

Utilities would be contracted for on a private basis with short extensions from the MP I plant. During normal power plant operations, parasitic electric power requirements would be satisfied by electric power generated on-site. During start-up operations, electric power would be purchased from SCE. This would not require any community service.

NOTE - Economics

/1/ Hot Creek Hatchery uses a water flow of approximately 8,980 gallons per minute (Fullerton, 1976). The heat required in British thermal units (BTUs) to raise the temperature of one gallon of water by 1°F is 8.3 BTUs. Assuming the springs feeding Hot Creek Hatchery lost the thermal component and and the average temperature dropped 2°C (3.6°F), the heat required to raise the temperature would be approximately 0.4 billion BTUs a day. (8.3 BTU per gallon-degree x 3.6°F x 8,980 gpm x 60 minutes per hour x 24 hours per day = 0.39 x 10^9 BTU per day.) The annual cost of providing 0.4 billion BTUs a day, assuming; 1) the energy is provided through the use of heating oil, 2) a barrel of oil can deliver 5.6 x 10^6 BTUs, and 3) a barrel of oil costs $18.25, is approximately $500,000. ((0.39x$10^9$ BTUs per day / 5.6x10^6 BTUs per barrel) x $18.25 per barrel x 365 days per year = $0.46x$10^6$ per year.) This annual fuel cost could be higher or lower depending on the actual change in water temperature, the type of fuel used, the efficiency of the energy conversion, and the cost of fuel. This estimate does not include the construction, maintenance, and other operating costs associated with such a project.

4.1.3.3 Recreational Resources

Operation of the plant would require pumping from the geothermal reservoir. There is no consensus on how subsurface thermal resources move within the Long Valley caldera so it is not possible to make a definitive statement about how operation of the plant would affect the springs which supply Hot Creek. Section 4.1.1.2 discusses the impacts of the project on water quality and hydrology. In that section two possible effects are identified. The first would be thermal contamination of surface water due to the rupture of lines feeding geothermal fluid to a power plant. The second, which is not predicted based on modelling of the system as it is now understood, is a decrease in either the volume or temperature of the water in the reservoir beneath Hot Creek Hatchery and Hot Creek Gorge. The following discussion is based on the assumption that adverse effects would occur. In fact, it is the intent of the monitoring program to identify adverse impacts based on observations made at the established monitoring points and to allow implementation of appropriate mitigation measures before Hot Creek is adversely affected.

Impact: If thermal springs at Hot Creek Gorge were depleted as a result of operating the MP II & III plants, it would represent the loss of a unique recreational resource for which no mitigation can be recommended.

Impact: The trout stocking program in California would be adversely affected if the temperature of water used at Hot Creek Hatchery were lowered by more than 2°F.

Mitigation:

- See Aquatic Resources, Section 4.1.2.3, and Economics, Section 4.1.3.2, for a discussion of hatchery operations.

Impact: If a spill of geothermal fluid resulted in significant mortality, fishing in Hot Creek would be temporarily adversely affected.

Mitigation:

- The effect would be temporary, so no mitigation is recommended beyond those described in Section 4.1.1.2.3, Hydrothermal Resources, to confine the spill. See also Section 4.1.2.3, Aquatic Resources.

Impact: There are no recreational facilities within the confines of the project area and other than jogging, no known recreational activities occur within the project area. However Forest Road 3S05 and Scenic Highway 395 and State Route 203 are near the proposed site and serve as the main access roads for dispersed recreational activities in the Little Antelope Valley. Recreationists driving, cycling, or jogging past the project area may be adversely affected by the noise and industrial appearance of the facility.

Mitigation:

- See Section 4.1.1.3, Noise, and Section 4.1.3.1, Visual, for suggested mitigations.

Impact: The power plant would attract the attention of people in the vicinity because it is so different from the surrounding scenery. Visitors to the area would be likely to drive by the plant to see it close-up and to satisfy their curiosity.

Mitigation:

- The project sponsor should be encouraged to participate in the installation of an informational display which passers-by could visit. It could be as modest as a kiosk or as ambitious as a formal visitors center, but it should describe the nature of the geothermal resource and how it is being utilized in a way that casual visitors could understand. Ideally this would be done in cooperation with the owners and operators of the other power plants in the area and coordinated with the U.S. Forest Service and Mono County Office of Geothermal Development.

4.1.3.4 Timber Resources

Impacts: Merchantable-size Jeffrey pine would be harvested during the clearing of 15 acres for the project. About nine acres would be on USFS land and six acres on private property. Where merchantable Jeffrey pines are present, timber volumes are estimated at 24,000 board-feet/acre. At this stocking rate, about 216,000 board-feet would be harvested from USFS land and 144,000 broad-feet from private property. An unknown percentage of this volume from USFS land is already under contract as part of the Bandit Timber Sale. The Bandit Timber Sale volume is scheduled for harvest during the winter of 1987-88 and 1988-89. An unknown number of unmerchantable trees would be removed during the clearing operations (McLean, 1987).

Mitigations:

- The operator should be required to purchase, at the prevailing market rate when the site is cleared, all merchantable timber harvested.

- Where feasible, well pads and pipelines should be sited in natural openings and clearings.

- Artificial clearings resulted from project development should be oriented to avoid clustering of small non-merchantable trees.

- Reclaimed portions of well pads and pipeline pads should be replanted with natural vegetation. Reclaimed portions should be fenced to promote the revegetation effort.

- The power plants facilities should be landscaped with natural vegetation.

4.1.3.5 Range Resources

Impacts: Construction of the proposed MP II & MP III project would remove approximately 22.5 acres of range land from active use. This area equals about four animal months (AMs). Half the area is USFS land within a range allotment and half is privately owned. The private land is not fenced and, although not part of the allotment, is grazed at the same level of intensity.

Mitigation:

- Revegetate all non-occupied cleared USFS range lands so that portions of the range could be eventually recovered. Revegetated areas should be fenced until the replaced material is well established.

4.1.3.6 Cultural Resources

Potential adverse impacts to cultural resources sites in the general vicinity of the MP II & III project may be of two kinds: direct and indirect. Direct adverse impacts would be expected if construction of the proposed facilities altered the location of or destroyed cultural resources or areas traditionally used by Native American groups. Indirect adverse impacts are less clear-cut and can be expected to occur beyond the actual spatial confines of direct impact both during construction and operation.

Direct Impact: In the immediate vicinity of proposed MP II & III project, cultural resource sites PLES-8 and PLES-9 may be subject to direct adverse impacts from the development of wells associated with the proposed plants. Unfortunately, because of the original mapping scale (Hall, 1986), it is unclear whether either site would be directly impacted by proposed construction activities. PLES-8, located on BLM Land Lease #11667A, was recorded as consisting of both a prehistoric and an historic component covering an area of approximately 785 square meters. The prehistoric component consists of a moderate scattering of obsidian debitage waste flakes; the historic remains include a tent or cabin foundation, milled lumber, saw-cut logs and cut-wire nails. This site, as mapped by the field archaeologists on a 15-minute USGS topographic map, is north of proposed wells pad MPI 52A-32 and MPI 42B-32. PLES-9, located on private property owned by Magma Energy, Inc., consists of an moderate scattering of obsidian debitage waste flakes covering an area of approximately 1,240 square meters. The western boundary of the site, as mapped on the USGS 15-minute topographic map, is located north and east of proposed well sites MPI 52A-32 and MPI 52-32.

Mitigation:

- It would be necessary to determine first if proposed construction activities do, in fact, fall within the site boundaries of PLES-8 and/or PLES-9. It is therefore recommended that, before construction were to begin, an archaeologist visit the exact areas of planned development to assess whether or not either of these sites would be impacted. If neither PLES-8 nor PLES-9 is within the confines of proposed development, no further mitigation of direct impacts would be necessary.

  If proposed development would impact a portion of PLES-8 and/or PLES-9, it may be possible to locate the wells outside of the actual boundaries of the sites. If this is not feasible, the wells should be located in areas characterized by relatively low archaeological sensitivity. In such areas it is recommended that a two phase program of evaluation be adopted. This program would involve the initial mapping and systematic collection of surface cultural remains and limited subsurface test excavation to determine the extent of buried cultural deposits.

- If the results of the first phase of evaluation indicate that these areas of PLES-8 and/or PLES-9 are significant and no practical mitigation alternative exists, expansive data recovery investigations would be recommended.

Direct Impact: It is possible that subsurface cultural resources may be encountered, damaged, and destroyed during construction.

Mitigation:

- It is recommended that, to the extent possible, an effort be made to monitor development activities that may uncover buried cultural deposits. In the event that cultural remains are discovered during subsurface construction, land alteration in the general vicinity of the find should be halted and the Inyo National Forest Archaeologist should be consulted. Prompt evaluations by the California State Office of Historic Preservation and the National Forest Service would then be made regarding the finds, and the course of action acceptable to all parties could then be adopted.

Indirect Impact: Indirect adverse impacts may affect any cultural resources in the general vicinity of proposed geothermal development. Examples of indirect adverse impact to cultural resources are increased recreational land-use of localities near project facilities where archaeological remains are visible by the public or by construction and operating personnel.

Mitigation:

- Place locked gates on access roads which lead to culturally sensitive areas.

- Use a focused program of educating project personnel to develop an awareness of the surrounding cultural environment and the need to leave any cultural remains as they are found in the environment.

Indirect Impact: The Bishop Elders have voiced concerns about proposed geothermal development in areas where they have traditional Native American interests (Reynolds, 1987). Such interests include use of hot springs in the area for ritualistic purposes and the collection of special plants which grow near hot springs.

Mitigation:

- A representative of Mammoth Pacific met at the site with the Bishop Elders. The project sponsor has agreed that Native Americans would have continued access to resources important to their culture.

4.1.3.7 Transportation and Access

Impact: During the construction phases, which would occur during two nine-month periods, traffic would increase and would include heavy equipment. This could damage State Route 203 and Hot Springs Road and inconvenience users of the roads. The volume of traffic generated by the operational work force is not expected to significantly increase traffic.

Mitigation:

- As discussed in Section 4.1.3.2.3, under Street and Road Maintenance, the county may consider methods of transferring road repair and maintenance costs to the applicant.

Impact: Traffic is sometimes heavy on the on- and off-ramps connecting Highway 395 and State Route 203. The heavy equipment going to and from the site could aggravate congestion.

Mitigation:

- Redirect project traffic to Hot Springs Road near the County buildings so that it avoids the Highway 395/State Route 203 interchange.

4.2 ALTERNATIVE LOCATION

4.2.1 PHYSICAL ENVIRONMENT

4.2.1.1 Geology, Geologic Hazards, and Soils

4.2.1.1.1 Geology and Geologic Hazards

Impacts and mitigations associated with the alternative location are the same as for the proposed project.

4.2.1.1.2 Soils and Erosion

Construction of the power plants, access roads, well sites, pipelines and transmission lines would result in soil disturbance. The expected amount of total disturbance is approximately five acres for the power plant and 20 acres for well sites. About 1,800 feet of access roads in addition to the existing dirt roads would be built; this would result in disturbance of approximately one acre. Access roads would be sited to avoid cultural and biological resources. Installation of pipelines would disturb an additional one-half acre. Total site development would result in the temporary disturbance of no more than 27 acres. Most of the new access roads would be built on USFS land and used to reach the injection wells for MP III; the other areas could be reached on existing dirt roads which lead to the SCE substation and existing wells for MP I. After completion of construction and revegetation, about five acres of dirt access roads and cleared areas around wells would remain unvegetated for the life of the project. Table 4-16 summarizes the disturbed area by land ownership.

All mitigation measures are the same as for the proposed project.

Grading would be necessary on the plant site to create level areas. Based on estimates from the topographic map in Figure 2-2, the relief across the plant site is probably no more than 15 feet. If the five acre power plant site were graded to one elevation, then approximately 15,000 cubic yards of dirt would be removed from the higher areas and used to fill the lower areas.

TABLE 4-16: APPROXIMATE ACREAGE OF DISTURBED SOIL ON PRIVATE AND USFS LAND FOR PROPOSED PROJECT

	USFS (acres)		Private Land (acres)	
Units	Short-Term	Long-Term	Short-Term	Long-Term
Power Plants	0.0	0.0	5.0	5.0
Wells/a/	10.0	4.0	10.0	4.0
Access Roads	0.7	0.7	0.3	0.3
Pipelines	0.3	0.0	0.2	0.0
TOTAL	11.0	4.7	15.5	9.3

/a/ 1.25 acres/well for short-term disturbance and 0.5 acres/well for long-term.

SOURCE: Environmental Science Associates, Inc.

4.2.1.2 Water Quality and Hydrology and Noise

Water quality and hydrology and noise impacts for the alternative would be the same as for the proposed project.

4.2.1.3 Air Quality

The isopentane working fluid which would be used in the alternative power plants is similar to the isobutane working fluid of the proposed project. Leaks of equal volume would therefore have similar impacts. No detailed information is available about likely emissions of working fluid for the alternative power plants, so it is assumed that the operating emissions would be similar to those of the proposed project; that is, between 200 and 1,000 lbs per day of working fluids. The other air quality impacts would be the same as for the proposed project.

4.2.2 BIOLOGICAL ENVIRONMENT

4.2.2.1 Vegetation

A loss of up to 27 acres of sagebrush scrub, Jeffrey pine, Jeffrey pine/pinon pine, and rhyolite buckwheat scrub plant communities would occur from construction of the MP II & III plants, well fields, and pipelines. Based on site maps prepared by the proponent and vegetation maps prepared by Taylor and Buckberg (1987), it is estimated that less than 17 acres of Jeffrey pine, less than seven acres of sagebrush scrub, and about 1.25 acres each of Jeffrey pine/pinon pine and pinon/juniper woodland would be directly impacted. Approximately one acre of rhyolite buckwheat scrub, a botanically sensitive plant community, would be impacted. These potential losses are detailed by ownership in Table 4-17. About one-half acre of the proposed power plant site is already a disturbed ruderal area.

TABLE 4-17: ESTIMATED ACRES OF HABITAT LOSS BY LAND OWNERSHIP FOR ALTERNATIVE

	Jeffrey Pine	Sagebrush Scrub	Jeffrey Pine/ Pinon Pine	Pinon/Juniper Woodland	Rhyolite Buckwheat Scrub
USFS	9.00	2.00	0.00	0.00	0.00
Private	7.25	4.25	1.25	1.25	1.00
TOTAL	16.25	6.25	1.25	1.25	1.00

SOURCE: Environmental Science Associates, Inc.

All mitigations would be the same as for the proposed project, except that there would be a larger area requiring revegetation because the three acres of presently disturbed land would not be used as part of the plant site.

4.2.2.2. Terrestrial Wildlife and Aquatic Resources

The impacts and mitigations for the alternative would be the same as for the proposed project.

4.2.3 SOCIAL ENVIRONMENT

4.2.3.1 Visual Resources

Existing mature trees located south and southeast of the alternative location would provide some screening for the power plants, so there would be less reliance on revegetation to provide screening. In addition, the plants would be arranged so that MP II would partially obscure MP III.

All mitigation measures listed for the proposed project would apply to the alternative, except for the use of the alternative location.

4.2.3.2 Socio-economics

The impacts of the alternative would be the same as for the proposed project.

4.2.3.3 Recreational Resources

If the plants are less visible in the alternative location than the proposed location, there would be less impact on passers-by.

4.2.3.4 Timber Resources

Up to 18.75 acres of forest and woodland would be lost. This is 3.75 acres more than for the proposed project. At the stocking rate of 24,000 board feet per acre, up to 90,000 additional board feet would be harvested, all from private property. The same mitigation measures as suggested for the proposed project would apply to the alternative.

4.2.3.5 Range Resources

The alternative would remove about 3.5 acres more than the proposed project from use as range land, for a total of 26 acres. The additional land is equivalent to about 0.6 AM; but, although it is grazed at the same level of intensity as the USFS land, it is all located on private land and is not part of the federal lease. The same mitigation measures would apply to the alternative as to the project.

4.2.3.6 Cultural Resources

The alternative site lies adjacent to two cultural resource sites (Hall, 1986). Cultural resource site PLES-10, which lies immediately south of the power plant site, consists of both prehistoric and historic component covering an area of approximately 250,000 square meters. The prehistoric component consists of a moderate scattering of obsidian debitage flakes, several osidian blank/tool production loci and a bedrock mortar locus. The historic remains include a standing log cabin and scattered tin cans, bottles, metal, wood and rubber items.

Cultural resource site PLES-7 lies east of the southeastern corner of the alternative site. The PLES-7 site, covering approximately 3,142 square meters, includes both prehistoric and historic components. The prehistoric component consists of a scattering of obsidian debitage flakes. The historic remains include a kaolin mining pit, crimped-seam tin cans of various sizes, cobalt-blue glass bottle sherds, crockery and porcelain fragments, a late 1920's or early 1930's automobile body, and miscellaneous pieces of metal most likely representing automobile parts.

Vehicles and equipment approaching or leaving the alternative site could damage sensitive cultural resources. Vehicles and equipment should be restricted to designated areas for parking or turning vehicles and equipment and storing supplies. Potential indirect impacts are the same as for the proposed project.

Mitigation measures for the project would apply to the alternative.

4.2.3.7 Transportation and Access

Transportation and access impacts would be the same for the alternative as for the proposed project.

4.3 NO-PROJECT ALTERNATIVE

The No-Project Alternative would leave existing environmental conditions at the site unchanged. The immediate area would continue to be dominated by the existing MP I power plant.

The No-Project Alternative would decrease employment opportunities for an average of 48 construction jobs over a nine-month period and for six full-time jobs. The creation of a negative climate for geothermal power generation may decrease opportunities for future employment in this sector. There would be no effect upon the current population and housing situation.

In addition, the No-Project Alternative would deny the county considerable property tax and geothermal lease revenues.

The creation of a negative atmosphere for future geothermal exploration and development would decrease future geothermal lease activities, thereby further decreasing county revenues.

5.0 OVERVIEW OF IMPACTS

5.1 UNAVOIDABLE ADVERSE IMPACTS

5.1.1 VISUAL RESOURCES

In the interest of providing uniform environmental review, the Mono County Energy Management Department has stated that they will employ the same standards for Visual Resource Management which the USFS uses for the federal property surrounding the private land included in the MP II & III project. Using those standards, the proposed project would be located entirely in an area which the USFS has assigned a Visual Management Objective (VMO) of "Retention." Any change in a Retention area which is noticeable to the casual observer is in conflict with the Retention VMO. In this case, the power plants, even with all the mitigation measures, would be noticed by a casual observer and would therefore not conform to the VMO established for the area. The County may also require the applicant to pursue an alternate plant location to lessen the visual impacts.

5.1.2 GEOTHERMAL RESOURCES AND RECREATION

Knowledge about the subsurface hydrology and the geothermal resource in Long Valley caldera is limited. Two models have been proposed to account for the observed behaviour and characteristics. One of these, the Upwelling/Fracture Flow Model, states that separate geothermal reservoirs supply Casa Diablo and Hot Creek. Consequently, there could be no impacts to reservoirs supplying Hot Creek thermal springs due to pumping at Casa Diablo. According to the second model, the Lateral Flow Model, geothermal fluid originates in the southwest caldera and flows generally eastward toward Casa Diablo and Hot Creek. If this second model is correct, there could be hydraulic communication between the Casa Diablo and Hot Creek areas.

The existence of hydraulic communication throughout the southern part of the caldera would represent a worst-case scenario. The Lateral Flow Model represents such a case and has been used in this report as the basis of a worst-case scenario. Using this model, calculations were done to estimate the change in pressure (i.e., water level) in the reservoir underlying Shady Rest, Casa Diablo, Colton Spring, Hot Creek Hatchery, and Hot Creek Gorge due to production and injection at MP II & III. Calculations were also done to estimate the distance that cooler injected fluid would move away from Casa Diablo.

Both sets of calculations indicate that there would be no adverse impacts on either the pressure of geothermal fluid or its temperature in the reservoir underlying springs which feed Hot Creek Hatchery or Hot Creek Gorge.

That having been said, the conclusion must be weakened somewhat by stating that the calculations were unavoidably based on a number of simplyfying assumptions about how fluid moves through the reservoir and on the fragmentary information currently available about the reservoir characteristics. It is unlikely but not impossible that the springs supplying Hot Creek Hatchery and Hot Creek Gorge could be adversely affected. Only if this unlikely effect were to occur would the project have a significant unmitigable effect on recreational use of Hot Creek Gorge. The effects on Hot Creek Hatchery could be mitigated by supplying sufficient hot water from another source, such as a geothermal well.

5.2 GROWTH-INDUCING IMPACTS

Although additional geothermal development would benefit the local economy by broadening the fiscal base, the lifespan of geothermal production within the area is limited by the quantity of the resource present and the operational parameters of the power plant. No additional industrial activity is expected to be induced by the presence of the geothermal plant. There is no current shortage of electrical energy in the area acting to control growth. To the extent that county services are increased as a result of increased revenue, the county may become more attractive to potential residents.

5.3 CUMULATIVE IMPACTS

Numerous projects have been proposed for the Mammoth Lakes area which cumulatively could have profound impacts on the environment. Not all the the proposed projects will actually be built and not all are appropriate for discussion in this document, so in consultation with the Energy Management Department and the BLM, the list shown below in Table 5-1 has been used as a basis for discussion. Because the geographic area appropriate for discussion varies with the resource under discussion, not all the projects are included in each discussion. The table summarizes which projects were considered for each topic. The locations of the projects are shown in Figure 5-1.

TABLE 5-1: MAMMOTH LAKES AREA PROPOSED PROJECTS CONSIDERED IN THE CUMULATIVE ANALYSES

	MP II & III	PLES I	Mammoth/ Chance I and II	Doe Ridge	Snow Creek	Sherwin Bowl	Juniper Ridge
Geology, Geologic Hazards, Soil	X	X	X				
Water Quality and Hydrology	X	X	X	X			
Noise	X	X					
Air Quality	X	X	X				
Biological Resources	X	X	X	X	X	X	X
Visual Resources	X	X					
Socioeconomics	X	X					
Recreation	X	X	X	X			
Timber	X	X					
Range	X	X					
Cultural Resources	X	X	X				
Transportation and Access	X	X					

SOURCE: Environmental Science Associates, Inc.

Insert Figure 5-1

5.3.1 PHYSICAL ENVIRONMENT

5.3.1.1 Geology, Geologic Hazards, and Soils

One operating geothermal power plant (MP I) is already in place and five additional plants (MP II & III, PLES I, and Mammoth/Chance I and II) are proposed in the Casa Diablo/Hot Creek area. Other projects in the watershed in various stages of environmental review include the Doe Ridge Airport Expansion Project, Sherwin Bowl, Snow Creek, and Juniper Ridge. The construction of any one of the proposed projects within the Mammoth Basin watershed would cause increased sedimentation in the streams. Careful execution of mitigation measures during and after construction can reduce the impact. However, the acreage involving major surface disturbance unprotected by erosion control measures at one time should be limited so that the unavoidable increase in sediment load in the streams can be minimized. If effective, revegetation programs at the power plants, even if all are constructed, should minimize long term impact.

5.3.1.2 Water Quality and Hydrology

Several developments requiring geothermal fluid and/or freshwater have been proposed for the south caldera region. For purposes of the cumulative hydrology analysis, the following existing or proposed projects are being considered:

- MP I, the existing geothermal power plant;
- Chance Ranch, the ranch near the county buildings on Hot Springs Road;
- MP II & III, two proposed 10 MW (net) geothermal power plants;
- PLES I, one proposed 10 MW geothermal power plant;
- Mammoth/Chance I and II, two proposed 20 MW geothermal power plants; and ?
- Doe Ridge, the airport expansion project.

5.3.1.2.1 Surface Water

The primary threat to surface freshwater resources is from spills of geothermal fluid, petroleum products and other chemical compounds which may be used on-site for construction, maintenance and drilling. The probability of contamination from spills or natural runoff from contaminated soils is low, but increases with each additional power plant installed or under construction. However, the chance of having an event such as a spill or well blowout occurring at more than one power plant at any given time is remote.

Runoff from the proposed golf course containing fertilizer and pesticide residues could cause degradation of surface water quality, but that pollution would be quite different from the materials which would originate at geothermal power plants and a discussion of its impact is beyond the scope of this document.

Assuming each power plant at Casa Diablo would need approximately the same quantity of freshwater as MP I, four times as much as is currently pumped would be required. Increased production, possibly including a new well, could lower the freshwater table locally. No other uses of this supply are known or anticipated, but shallow rooted vegetation could be affected.

The other potential and active users of shallow fresh groundwater within the Mammoth Creek Basin include: 1) Mammoth/Chance I and II cooling water of approximately 320 gpm per 10 MW; 2) Chance Ranch, seasonal and intermittent, approximately 20 to 30 gpm; ahd 3) Doe Ridge, up to 670 gpm for the full scale development.

These projects may have an impact on each other and on Hot Creek Hatchery, but no cumulative impact is likely to result from the low-level usage planned at Casa Diablo. The shallow groundwater at Casa Diablo is associated with shallow alluvial material that appears to thin out southeast of Casa Diablo, and neither the alluvium nor a significant shallow freshwater resource is believed to be continuous down slope toward the Chance Ranch, Mammoth/Chance or Doe Ridge projects. A greater thickness of alluvium along with a larger freshwater aquifer is believed to occur in those areas. In summary, little effect on other aquifers can be anticipated from fresh groundwater production at Casa Diablo.

Far more data than is available in the Mammoth/Chance and Doe Ridge EIRs would be necessary for assessment of potential hydrologic consequences resulting from development of those two projects. It should be noted that the Doe Ridge wells may be drilled in the Convict Creek Drainage Basin which is geographically isolated from the Mammoth Creek Basin which includes all other projects discussed here. It is possible for the two basins to be connected hydraulically in the shallow alluvium and basalts along the margins, but no such relationship has been established.

5.3.1.2.2 Hydrothermal Resources

The six geothermal plants existing or proposed for the Casa Diablo-Hot Creek area were used in a computer simulation of reservoir behavior. The results, plotted in Figure 5-2, are shown as pressure changes in the subsurface reservoir below four areas with springs: Shady Rest, Casa Diablo, Colton Spring, Hot Creek Hatchery, and Hot Creek Gorge.

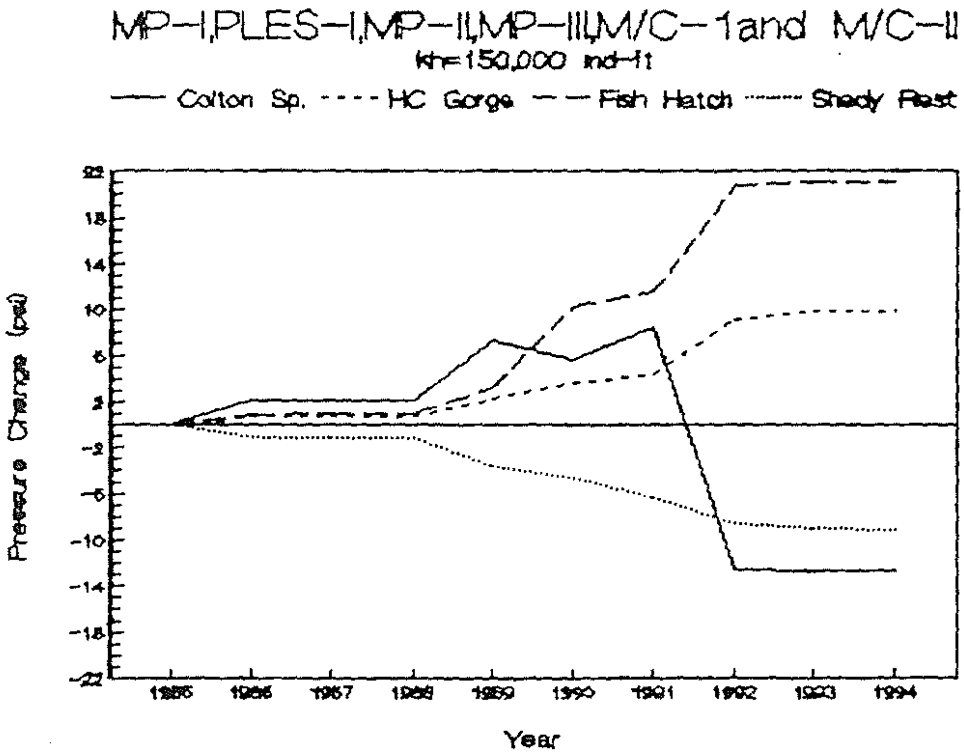
The calculations apply only to a simplified version of the Lateral Flow Model and do not represent the Upwelling/Fracture Flow Model. The latter model would be difficult to simulate on the basis of current data; the former was chosen to represent a worst-case scenario for the analysis of environmental impacts.

The calculations were done using the same assumptions and simplifications as described in Section 4.1.1.2 and therefore provide only an approximate indication of what would happen. When more data are available about the reservoir, more refined modeling may be possible.

The cumulative effect of all six geothermal power plants is predicted to cause pressure rises in the subsurface reservoir below Hot Creek Gorge and Hot Creek Hatchery due to the pattern of injection wells and the planned 100% injection at MP II & III and PLES I and 95% injection for the Mammoth/Chance projects. The pressure below Shady Rest is predicted to decline if all six plants are in operation.

In the reservoir below Colton Spring, pressure is predicted to rise until Mammoth/Chance II begins operation, at which time calculations indicate that the pressure would decline.

It must be emphasized that all the results described in this report are based on uniform horizontal and vertical permeability which may allow a higher calculated degree of injection support than in fact may occur given natural conditions. It was not possible to



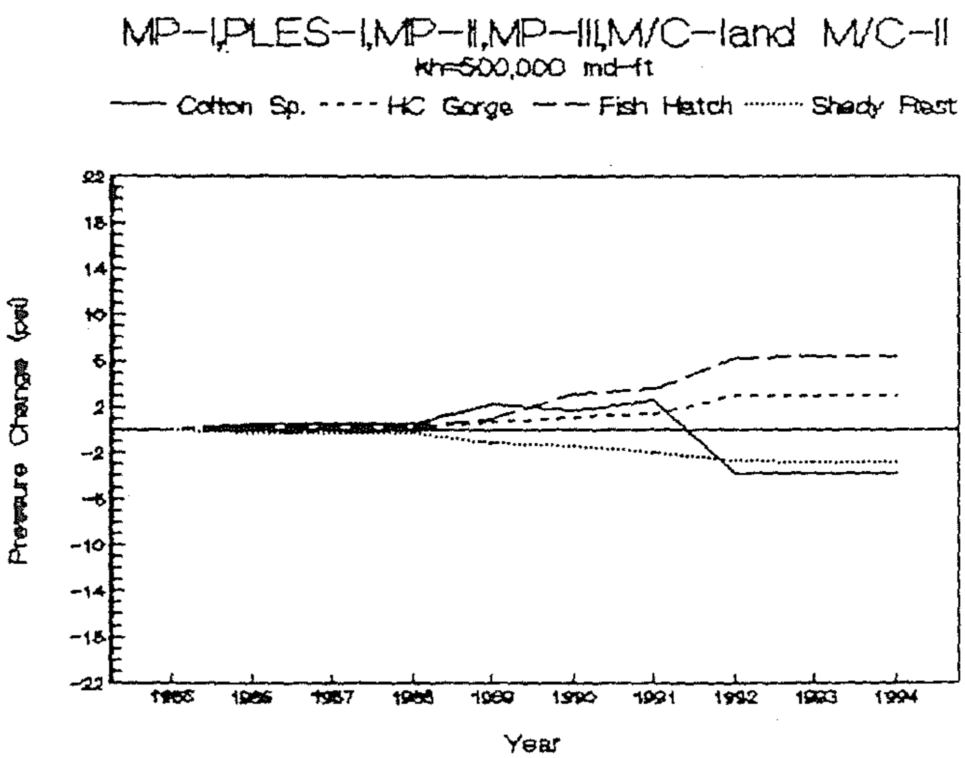


FIGURE: 5-

Pressure Changes in Subsurface Resen
for Cumulative Cas

SOURCE: BGI, 1987

include anisotropy in the computer model due to a lack of quantitative data on the pressure of a horizontal low flow boundary. Also, there are no data presently available that suggest injected fluid would not support pressures in hot springs areas even if anisotropy or preferred flow paths existed. If such inhomogenieties exist, they may not significantly affect thermal resources outside Casa Diablo if the results observed during monitoring of springs since the MP I power plant operations bagan in 1984 is an accurate indication of impacts.

5.3.1.3 Noise

If all three geothermal plants, MP II, MP III, and PLES I were constructed at Casa Diablo and each plant had noise generating and abatement capacities similar to those documented for the existing MP I plant, geothermal-related noise would probably not be audible above background noise at the closet existing sensitive receptors. This estimate is based on a worst-case noise level of about 75 dBA, L_{eq}, at 100 feet generated by the one existing and the three proposed plants (noise level without noise muffling devices), and noise attenuation of three decibels for every doubling of distance. The combined worst-case noise level of four plants would be about 81 dBA, L_{eq}, at 100 feet. This noise level would be attenuated by distance alone to about 55 dBA, L_{eq}, at 2,000 feet and to about 45 dBA, L_{eq}, at the closest sensitive receptors, 1.25 miles to the east.

Noise-sensitive development and recreational users within 2,000 feet of four geothermal plants of this design could be exposed to outdoor noise levels above 55 dBA, L_{eq}. This noise level has been identified by the U.S. EPA as causing interference with outdoor activities (U.S. EPA, 1974). No noise sensitive development is currently planned for areas within 0.5 miles of the project site (Lyster, 1987). In addition, no changes to existing topography or vegetation which may result in changes in the acoustic environment are planned.

5.3.1.4 Air Quality

If five additional geothermal plants were constructed and each plant had air emission characteristics as described in Section 4.1.4, the greatest anticipated impact would be particulate matter levels from construction activities. If nine months were required for each plant and construction activities were timed consecutively, inhalable particulate (PM_{10}) levels in the area could exceed state standards for approximately four years. Given the high PM_{10} levels recorded in the Town of Mammoth Lakes, this additional dust loading may have a noticeable impact on regional visibility and may be cause for health concerns.

The presence of the additional power plants would not result in regional, commercial, or residential development that could adversely affect regional air quality.

Estimates of ground-level isobutane concentrations from system leaks were obtained with PTPLU. Estimates were made under the assumption that leaks occurring at the many valves and seals could be combined into a single source of combined magnitude (i.e. 250 to 1,000 lbs/day). For the cumulative case where six virtually identical plants would be operating simultaneously, it was assumed that emissions from a single point source would range from 1,500 to 6,000 lbs/day.

Results of these calculations are shown in Table 4-7. They indicate that ground-level concentrations within 20 meters of the source would not reach dangerous levels (1.8 to 8.4% of air) on days with very stable atmospheres and low wind speeds even if the total leakage from six plants were emitted from a single point.

5.3.2 BIOLOGICAL ENVIRONMENT

Assessment of cumulative impacts requires placing the proposed project in the context of other proposed developments in the area. Six additional projects, which could impact biological resources occurring on the MP II & III site, are being considered in this discussion. These are:

- PLES I power plant;
- Mammoth/Chance I and II power plants;
- Sherwin Bowl;
- Juniper Ridge;
- Snow Creek condominium development; and
- Doe Ridge airport expansion and golf course.

5.3.2.1 Vegetation

The Mammoth/Chance I and II, Mammoth Pacific II & III, and PLES I geothermal plants would remove about 60 acres of sagebrush scrub, Jeffrey pine, Jeffrey pine/pinyon pine and mountain meadow plant communities. Exact acreages are dependent on final site configuration. The Snow Creek, Sherwin Bowl and Juniper Ridge developments, which are at higher elevations than the geothermal plants, would impact several coniferous forest and riparian plant communities in addition to sagebrush scrub and mountain meadows. Approximately 300 acres of these plant communities could be directly impacted by these developments. The Doe Ridge airport expansion may directly impact another 200 acres of sagebrush scrub.

If all of these projects are developed, approximately 600 acres (slightly less than one square mile) of natural vegetation would be lost, much of it on USFS land. Of the 600 acres lost, a total of less than 26 acres would be caused by MP II & III. If revegetation measures are successful, some of this acreage would be reclaimed. Impacts to major widespread plant communities, such as sagebrush scrub, are not expected to be significant. Impacts to unique or uncommon plant communities, such as riparian corridors and thermal marshes, could be significant. The loss of about 600 acres of wildlife habitat will contribute to the decline of wildlife productivity in the area.

5.3.2.2 Terrestrial Wildlife

Impacts to local deer herds are potentially significant. While summer and winter ranges would be largely unaffected, deer migration routes, which are a vital link in deer ecology, could be severely disrupted by development of the proposed projects (see Figure 5-1). Each of the proposed projects is within the migration routes of the Sherwin grade and/or Casa Diablo deer herds. Disruption of migration would lead to a decline in deer populations, which are currently stable.

Swall Meadow has been identified as extremely critical for deer migration in the region. Protection of this area through acquisition by the BLM, USFS, or a conservation organization would provide significant protection for local deer herds.

Populations of endangered, threatened and special status species are not expected to be impacted by development of these projects. USFS indicator species, such as pygmy nuthatches, hairy woodpeckers and pine martens, could be adversely impacted. The severity of the cumulative impacts depends on final project designs and success of mitigation measures.

5.3.2.3 Aquatic Environment

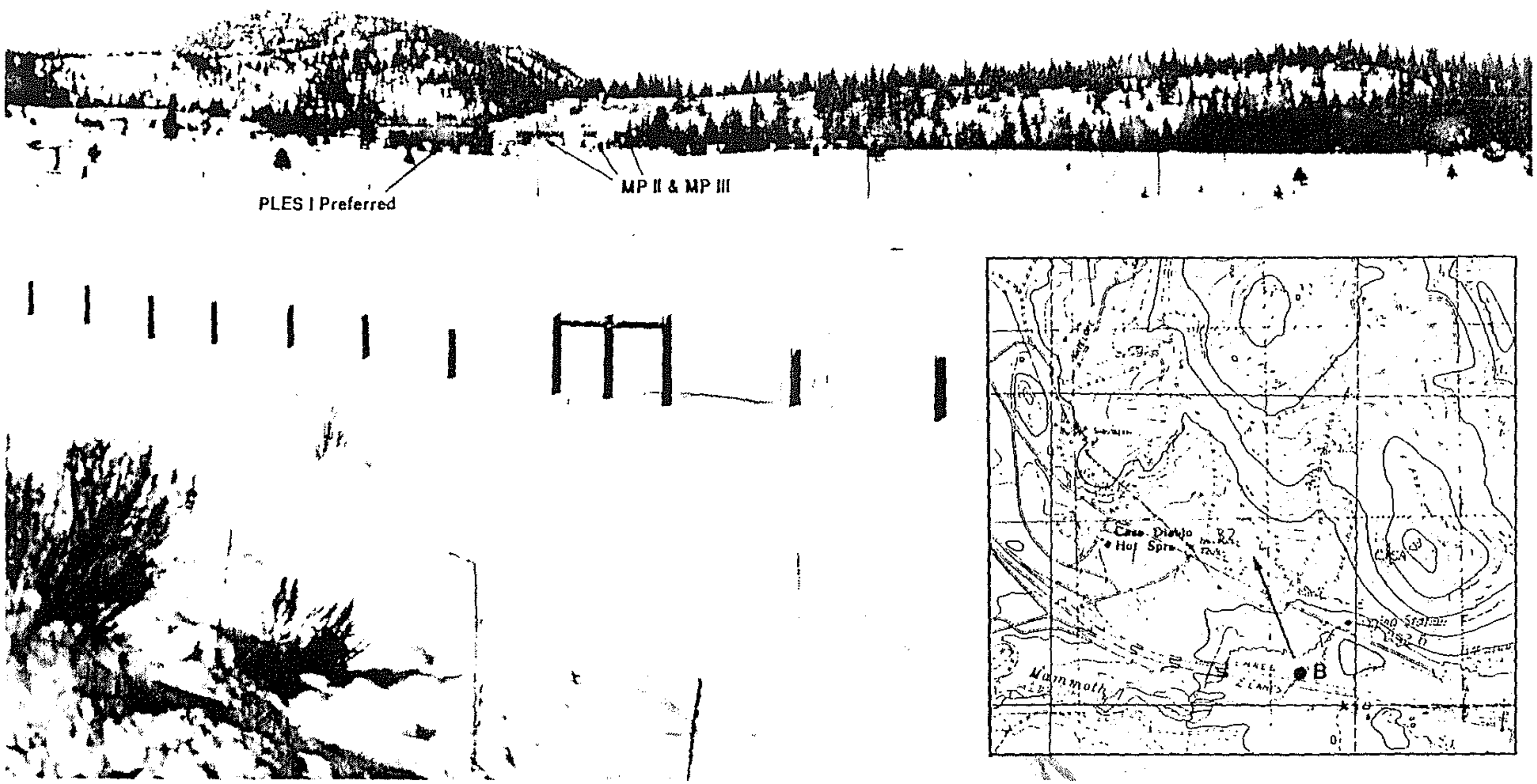
A total of six geothermal plants of about the same size either exist or are proposed for the area. These six plants are MP I, MP II & III, PLES I, and Mammoth/Chance I and II. Frequency and duration of adverse impacts to the existing aquatic biota would be a consequence of increased development. These impacts would be contamination of surface water, depletion of surface and sub-surface flows, and changes in water temperatures. Each development increases the likelihood of harmful spills which range from diesel fuel, gasoline, or oil to the release of geothermal fluids. Temporary increases in turbidity from disturbed soils at construction and road sites would be likely. The possibility of significant adverse impact to native fish species, trout strains unique to this system, aquatic invertebrates, and those species dependent on these resources would increase with increased development.

Known refugia of Owens Tui Chub are not likely to be affected by the geothermal plants near Casa Diablo. However, it is possible that shallow groundwater flows and the water quality of surface runoff near the known refugia could be affected by the Doe Ridge project. The Owens Tui Chub will be protected pursuant to stipulations rendered by a biological opinion to be prepared by USFWS as specified by Section 7 of the Endangered Species Act. See Section 4.1.2.3.2 for a discussion of the Owens Tui Chub.

5.3.3 SOCIAL ENVIRONMENT

5.3.3.1 Visual Resources

The addition of MP II & III and PLES I to the existing MP I power plant would create a discontinuous band of visible structures at the Casa Diablo area. Figure 5-3 is a photomontage illustrating the effect as seen from the major viewing point from



SOURCE: Environmental Science Associates

FIGURE: 5-3

Photomontage of MP II & III and PLES I in Existing Setting northbound Highway 395 near the Mammoth Creek crossing. The scattered trees provide some screening and interruptions in what would otherwise be an almost continuous row of power plants in the background views across the meadow.

The PLES I project, proposed for a site across the road from the proposed MP II & III site, would add man-made elements to the landscape at the expense of natural features. The existing and proposed facilities are close enough to one another that, in views from Highway 395 and State Route 203, all four power plants and large portions of the other geothermal facilities for each operation would be in the same field of view. The cumulative visual effect of the project, in combination with the existing MP I and the proposed PLES I, may be to create an industrial park appearance. Any of the mitigation measures suggested in Section 4.1.3.1, if adopted, would reduce the project's contribution to this cumulative impact. In addition, siting the MP II & III plant farther from the other existing and proposed facilities, assuming that the visibility of the site and the visual quality of the alternative site were comparable to the existing site, would decrease this cumulative effect in direct proportion to the distance between the power plants.

5.3.3.2 Socioeconomics

5.3.3.2.1 General Socioeconomic Impacts

Five additional geothermal electric generating plants currently proposed for the Casa Diablo/Hot Creek areas are each sized to produce about 10 megawatts of electricity, similar to the operational Mammoth Pacific I geothermal project. The socioeconomic cumulative impacts are expected to be approximately four times as great. Attendant with the population increases and more intensive land uses that accompany geothermal development would be increased demands on public services and housing. Simultaneous construction of two plants could tighten the housing market and the cumulative public service demand would probably pass a "threshold" level and require the addition of fire, police and school personnel.

5.3.3.2.2 Land Use and Planning

Continuing geothermal resource development within federal and private lands in the Long Valley will affect land uses directly by transforming several undeveloped areas to industrial uses. Geothermal development under environmental review by Mono County at Casa Diablo is consistent with Mono County and Inyo Forest Plans except for the Visual Management Objectives for the area. A total 30 to 35 acres of open space and grazeland are lost in the development of the proposed Casa Diablo geothermal projects (MP II & III, PLES I).

5.3.3.3 Recreational Resources

It is unlikely but possible that cumulative development of geothermal plants would deplete the springs at Hot Creek Gorge and cause the loss if its recreational value. Temporary impacts to the trout fishing in Mammoth Creek could occur if a major spill of geothermal fluid caused thermal shock to the fish. Depletion of the hot springs at Hot Creek Hatchery is also unlikely and could be mitigated by supplying hot water from another source..

5.3.3.4 Timber Resources

Construction of PLES I and MP II & III would result in the clearing of up to 18 acres of timber. At stocking rates of 24,000 board-feet/acre, a total of 432,000 board-feet of merchantable Jeffrey pines would be harvested.

5.3.3.5 Range Resources

Up to 41 acres of land would be removed from use as rangeland by construction of MP II & III and PLES I. This represents approximately 7 AMs. About 12 acres are private property and, although used at the same level of intensity as the USFS land, they are not part of the allotment.

5.3.3.6 Cultural Resources

A total of six geothermal power generation plants of similar size either exist or are proposed for the area. These six plants are MP I, MP II & III, PLES I and Mammoth/Chance I and II. Their cumulative adverse impacts would be greater than for any one facility. These impacts include, but are not limited to, cultural resource site disturbance and/or total site destruction.

Without a program of identification of the cultural resources existing within the entire geothermal development project area, it can be assumed that some type of disturbance and/or destruction of cultural resources will occur. Cultural remains are non-renewable resources and the incompatibility of these sites and proposed geothermal development will remain a significant factor within the area. As geothermal development of the region increases, it will become more difficult to relocate construction sites and access roads to avoid potential adverse impacts to identified cultural resources. In turn, the only alternative that remains is a comprehensive, systematic data recovery plan of these cultural resources sites and this, in and of itself, results in the ultimate destruction of the site.

Upon the preliminary siting of future facilities, an on-site inspection, evaluation, and mitigation of any identified areas of cultural resource significance should be made mandatory prior to the commencement of construction activities.

5.3.3.7 Transportation and Access

If more than one geothermal plant is under construction at one time, State Route 203 east of Highway 395 and Hot Springs Road could become congested. Operational traffic from all three plants is unlikely to affect service near Casa Diablo.

6.0 AGENCIES, ORGANIZATIONS, AND INDIVIDUALS CONSULTED

The following public agencies, private organizations, and individuals were consulted to obtain information for preparation of this environmental impact report.

6.1 PUBLIC AGENCIES

6.1.1 FEDERAL

Bureau of Land Management
- Terry Russi, Wildlife Biologist
- Mark Ziegenbein, Geologist

U.S. Geological Survey
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- Bob Wood, Winter Sports Specialist

U.S. Fish and Wildlife Service
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Bruce Malby, President, Board of Directors, Long Valley Fire Protection District
Marilyn Martin, Secretary to the Superintendent, Mammoth School District
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6.1.4 OTHER LOCAL AGENCIES

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7.0 REPORT CONTRIBUTORS

This report was prepared under contract to the County of Mono by Environmental Science Associates, Inc. (ESA). Berkeley Group Incorporated (BGI) prepared the hydrology report which was used as a basis for the hydrology sections in the body of this EIR.

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APPENDICES

APPENDIX A

ENVIRONMENTAL CHECKLIST FORM

(To Be Completed By Lead Agency)

I. Background

1. Name of Proponent MAMMOTH PACIFIC
2. Address and Phone Number of Proponent 2055 East Washington Blvd.
   Commerce, CA 90040
   (213)725-1139
3. Date of Checklist Submitted 10-21-86
4. Agency Requiring Checklist Mono County Energy Management Dept.
5. Name of Proposal, if applicable Mammoth Pacific: Units II & III

II. Environmental Impacts

(Explanations of all "yes" and "maybe" answers are required on attached sheets.)

	Yes	Maybe	No
1. Earth. Will the proposal result in:			
a. Unstable earth conditions or in changes in geologic substructures?		X	
b. Disruptions, displacements, compaction or overcovering of the soil?	X		
c. Change in topography or ground surface relief features?			X
d. The destruction, covering or modification of any unique geologic or physical features?			X
e. Any increase in wind or water erosion of soils, either on or off the site?	X		
f. Changes in deposition or erosion of beach sands, or changes in siltation, deposition or erosion which may modify the channel of a river or stream or the bed of the ocean or any bay, inlet or lake?		X	

	Yes	Maybe	No
g. Exposure of people or property to geologic hazards such as earthquakes, landslides, mudslides, ground failure, or similar hazards?	X		
2. Air. Will the proposal result in:			
a. Substantial air emissions or deterioration of ambient air quality?		X	
b. The creation of objectionable odors?		X	
c. Alteration of air movement, moisture, or temperature, or any change in climate, either locally or regionally?			X
3. Water. Will the proposal result in:			
a. Changes in currents, or the course of direction of water movements, in either marine or fresh waters?			X
b. Changes in absorption rates, drainage patterns, or the rate and amount of surface runoff?		X	
c. Alterations to the course or flow of flood waters?			X
d. Change in the amount of surface water in any water body?		X	
e. Discharge into surface waters, or in any alteration of surface water quality, including but not limited to temperature, dissolved oxygen or turbidity?		X	
f. Alteration of the direction or rate of flow of ground waters?	X		
g. Change in the quantity of ground waters, either through direct additions or withdrawals, or through interception of an aquifer by cuts or excavations?	X		
h. Substantial reduction in the amount of water otherwise available for public water supplies?			X
i. Exposure of people or property to water related hazards such as flooding or tidal waves?			X

		Yes	Maybe	No
4.	Plant Life. Will the proposal result in:			
	a. Change in the diversity of species, or number of any species of plants (including trees, shrubs, grass, crops, and aquatic plants)?		X	
	b. Reduction of the numbers of any unique, rare or endangered species of plants?		X	
	c. Introduction of new species of plants into an area, or in a barrier to the normal replenishment of existing species?		X	
	d. Reduction in acreage of any agricultural crop?			X
5.	Animal Life. Will the proposal result in:			
	a. Change in the diversity of species, or numbers of any species of animals (birds, land animals including reptiles, fish and shellfish, benthic organisms or insects)?		X	
	b. Reduction of the numbers of any unique, rare or endangered species of animals?			X
	c. Introduction of new species of animals into an area, or result in a barrier to the migration or movement of animals?	X		
	d. Deterioration to existing fish or wildlife habitat?	X		
6.	Noise. Will the proposal result in:			
	a. Increases in existing noise levels?	X		
	b. Exposure of people to severe noise levels?		X	
7.	Light and Glare. Will the proposal produce new light or glare?		X	
8.	Land Use. Will the proposal result in a substantial alteration of the present or planned land use of an area?		X	
9.	Natural Resources. Will the proposal result in:			
	a. Increase in the rate of use of any natural resources?	X		

	Yes	Maybe	No
b. Substantial depletion of any nonrenewable natural resource?			X
10. Risk of Upset. Will the proposal involve:			
a. A risk of an explosion or the release of hazardous substances (including, but not limited to, oil, pesticides, chemicals or radiation) in the event of an accident or upset conditions?	X		
b. Possible interference with an emergency response plan or an emergency evacuation plan?			X
11. Population. Will the proposal alter the location, distribution, density, or growth rate of the human population of an area?		X	
12. Housing. Will the proposal affect existing housing, or create a demand for additional housing?		X	
13. Transportation/Circulation. Will the proposal result in:			
a. Generation of substantial additional vehicular movement?	X		
b. Effects on existing parking facilities, or demand for new parking?			X
c. Substantial impact upon existing transportation systems?			X
d. Alterations to present patterns of circulation or movement of people and/or goods?			X
e. Alterations to waterborne, rail or air traffic?			X
f. Increase in traffic hazards to motor vehicles, bicyclists or pedestrians?	X		
14. Public Services. Will the proposal have an effect upon, or result in a need for new or altered governmental services in any of the following areas:			
a. Fire protection?	X		
b. Police protection?		X	
c. Schools?			X

	Yes	Maybe	No
d. Parks or other recreational facilities?			X
e. Maintenance of public facilities, including roads?		X	
f. Other governmental services?			X
15. Energy. Will the proposal result in:			
a. Use of substantial amounts of fuel or energy?			X
b. Substantial increase in demand upon existing sources of energy, or require the development of new sources of energy?			X
16. Utilities. Will the proposal result in a need for new systems, or substantial alterations to the following utilities:			
a. Power or natural gas?			X
b. Communications systems?			X
c. Water?			X
d. Sewer or septic tanks?		X	
e. Storm water drainage?			X
f. Solid waste and disposal?	X		
17. Human Health. Will the proposal result in:			
a. Creation of any health hazard or potential health hazard (excluding mental health)?		X	
b. Exposure of people to potential health hazards?		X	
18. Aesthetics. Will the proposal result in the obstruction of any scenic vista or view open to the public, or will the proposal result in the creation of an aesthetically offensive site open to public view?		X	
19. Recreation. Will the proposal result in an impact upon the quality or quantity of existing recreational opportunities?		X	
20. Cultural Resources.			
a. Will the proposal result in the alteration of or the destruction of a prehistoric or historic archaeological site?		X	

On the basis of this initial evaluation:

I find that the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared. [ ]

I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because the mitigation measures described on an attached sheet have been added to the project. A NEGATIVE DECLARATION WILL BE PREPARED. [ ]

I find the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required. [XX]

October 21, 1986
Date

Daniel Lyste
Signature

For ______________________

(Note: This is only a suggested form. Public agencies are free to devise their own format for initial studies.)

MAMMOTH PACIFIC II & III GEOTHERMAL PROJECT
ANNOTATED INITIAL STUDY ISSUES

The following is a summary of annotated comments which identifies specific issues related to all of the "yes" and "maybe" answers to questions provided on the Initial Study checklist discussed during the project scoping meeting of Tuesday, October 21, 1986:

1. Earth:

   a. Maybe - This issue was given a "maybe" answer because of possible concern for water/soil erosion during construction activities and the potential for subsidence resulting from long term fluid withdrawal from the geothermal reservoir.

   b. Yes - This issue was given a "yes" answer because of the potential for soil disturbance during construction and for possible surface subsidence as a result of long term fluid withdrawal from the geothermal reservoir.

   e. Yes - This issue was given a "yes" response because of the potential for increased wind and water erosion during construction activities.

   f. Maybe - This issue was given a "maybe" response because of the potential for erosion resulting from surface water runoff from cleared areas during construction and the possibility for sedimentation of surface waters downstream of the project area.

   g. Yes - This issue was given a "yes" response because of the potential for exposing on-site workers to geologic hazards.

2. Air:

   a. Maybe - This issue was given a "maybe" response only because of the potential for air emissions during some form of system upset such as, pipeline rupture or well blowout, and not for emissions anticipated during normal operations.

   b. Maybe - This issue was given a "maybe" response again only because of the potential for objectionable odors resulting from hydrogen sulfide emissions which could occur during a system upset such as, pipeline rupture or well blowout, and is not anticipated to be a concern during normal operations.

3. Water:

   b. Maybe - This issue was given a "maybe" response, again, only because of the potential for increased runoff as a result of an accidental spill of geothermal fluid. No changes are anticipated during normal operations.

   d. Maybe - This issue is, again, only related to the possibility for changes in surface water as a result of runoff from an accidental spill of geothermal fluid and is not a concern during the anticipated normal operations.

   e. Maybe - This issue was given a "maybe" response, again, only because of the potential for discharge into the ephemeral stream located within the project area as a result of an accidental spill of geothermal fluid. Discharge is not anticipated during normal operations.

   f. Yes - This question was given a "yes" response only because the project will be producing geothermal "waters" and injecting them in a new location. It does not refer to changes in non-thermal groundwater.

   g. Yes - This question was given a "yes" response only because the project will be producing geothermal "waters" and injecting them in a new location. It does not refer to changes in non-thermal groundwater.

4. Plant Life:

   a. Maybe - This question was given a "maybe" response because of the anticipated reduction in the number of plant species that will result from construction activities and not because of any anticipated loss of plant diversity in the project area.

   b. Maybe - This question was given a "maybe" response because the site has not yet been surveyed for sensitive species known to exist in Mono County.

   c. Maybe - New species may be introduced into the area only as a result of revegetation or site rehabilitation programs or as part of the landscape plan for the project.

5. Animal Life:

   a. Maybe - This question was answered "maybe" because of the potential for reducing the number of animal species in the project area not because of the potential for a change of diversity of animals species.

   c. Yes - This issue was given a "yes" response because of the possible impact on mule deer migration through the project area.

   d. Yes - This issue was given a "yes" response because of anticipated habitat destruction resulting from site construction and for possible effects upon aquatic animals living in conjunction with the hot springs in the project area and within the Hot Creek Fish Hatchery springs.

6. Noise:

   a. Yes - Past history at Mammoth Pacific Unit I indicates noise may be an issue.

   b. Maybe - Noise during drilling operations and noise during power plant operations could be severe for on-site employees.

7. Light and Glare: Maybe - Light or glare could result from night lighting.

8. Land Use: Maybe - The proposed project area is currently zoned general purpose.

9. Natural Resources:

   a. Yes - This issue was given a "yes" response because geothermal mineral resource will be utilized.

10. Risk of Upset:

   a. Yes - During system upset there is a potential for a release of geothermal fluid, isobutane, and for hydrogen sulfide emissions.

11. Population: Maybe - A slight potential exists to increase the local population as a result of the work force needed during construction and power plant operations.

12. Housing: Maybe - Because of the expected small population increase, housing demand should be considered for both the construction and power plant activity periods.

13. Transportation/Circulation:

 a. Yes - Vehicular traffic may be an issue for the brief period of proposed construction activity, but it is not an issue for the power plant operational period.

 f. Yes - Traffic hazards may be an issue for the brief period of proposed construction activity, but it is not an issue for the power plant operational period.

14. Public Services:

 a. Yes - This issue was given a "yes" response because of the use of the flammable hydrocarbon working fluid in the binary power plant.

 b. Maybe - This issue was given a "maybe" response because of the increased potential for vandalism at the power plant site.

 e. Maybe - This issue was given a "maybe" response because of potential impacts on old U.S. Highway 395 and California State Highway 203 from heavy equipment traffic.

16. Utilities:

 d. Maybe - This issue was given a "maybe" response because of the anticipated need for a new septic tank system at the facility.

 f. Yes - This issue was given a "yes" response because of the necessity for disposing of drilling muds and related wastes.

17. Human Health:

 a. Maybe - This issue was given a "maybe" response because of the potential for accidental occupational exposure to the isobutane working fluid and to hydrogen sulfide contained within the geothermal fluid.

 b. Maybe - Again this issue was given a "maybe" response because of the potential for occupational exposure to workers during system upsets.

18. Aesthetics: Maybe - This issue was given a "maybe" response because some people may be offended by the site of a geothermal power plant operation.

19. Recreation: Maybe - This issue was given a "maybe" response because of potential impacts on Hot Creek Gorge recreation (sightseeing and swimming), impacts on deer migration (impact on hunting), and impacts upon the fish hatchery (tourism).

20. Cultural Resources:

    a. Maybe - This issue is discussed in a pending cultural resource survey report for the entire project area.

    b. Maybe - This issue is discussed in a pending cultural resource survey report for the entire project area.

    c. Maybe - This issue is discussed in a pending cultural resource survey report for the entire project area.

    d. Maybe - This issue is discussed in a pending cultural resource survey report for the entire project area.

21. Mandatory Findings of Significance:

    a. Maybe - For all of the stated reasons given above.

    b. Maybe - This issue was given a "maybe" response for potential long term impacts upon the Hot Creek Gorge and the Hot Creek Fish Hatchery.

    c. Maybe - This issue was given a "maybe" response because the Mammoth Pacific II and III Project is only one of several small geothermal projects proposed in the Long Valley area.

    d. Maybe - This issue was given a "maybe" response because of the issue of aesthetics only.

It was decided that a focused Environmental Impact Report (EIR) should be prepared for the proposed project.

In addition to the checklist responses provided above, it was decided at the scoping meeting that the EIR should include a section on both cumulative impacts and growth-inducing impacts as required by the California Environmental Quality Act. It was also believed that a discussion should be included in the EIR which describes the Long Valley East Geothermal Unit Area and the relationship of the proposed project to the Known Geothermal Resource Area (KGRA) and the Unit Area.

NON-HAZARDOUS DRILLING MUD ADDITIVES

Aluminum sterate (aluminum tristearate)
Attapulgite clay
Bagasse (dried sugar cane)
Barium sulfate
Bentonite
Calcium carbonate
Causticized lignite (sodium lignite)
Cellophane
Chrome-free lignosulfonate
Cottonseed pellets
Diamines and fatty acid amides
Detergents
Ethylene oxide adducts of phenol and nonylphenol
Guar gum
Hydroxyethyl cellulose
Lecithin
Lignite
Magnesium oxide
Methanol
Mica
Morpholine polyethoxyethanol
Nut shells
Paraformaldehyde
Peptized bentonite
Phosphoric acid
Polyacrylamide resin
Polyanionic cellulosic polymer
Polysaccharides
Potassium chloride
Potassium hydroxide (caustic potash)
Potassium sulfate
Pregelatinized corn starch
Quartz or cristobalite
Rice hulls
Sawdust
Shredded paper
Sodium acid pyrophosphate
Sodium bicarbonate (bicarbonate of soda)
Sodium carbonate (soda ash)
Sodium carboxymethylcellulose
Sodium chloride
Sodium hexametaphosphate
Sodium hydroxide (caustic soda)
Sodium montmorillonite clay
Sodium polyacrylate
Sodium tetraphosphate
Starch
Tetrasodium pyrophosphate
Tributyl phosphate
Vegetable and polymer fibers, flakes, and granules
Vinyl acetate/Maleic anhydrite copolymer
Zanthan gum (XC polymer)

Source: California Department of Health Services

APPENDIX C

CASA DIABLO GEOTHERMAL DEVELOPMENT PROJECT:

DEER MIGRATION STUDY, SPRING 1987

Thomas E. Kucera

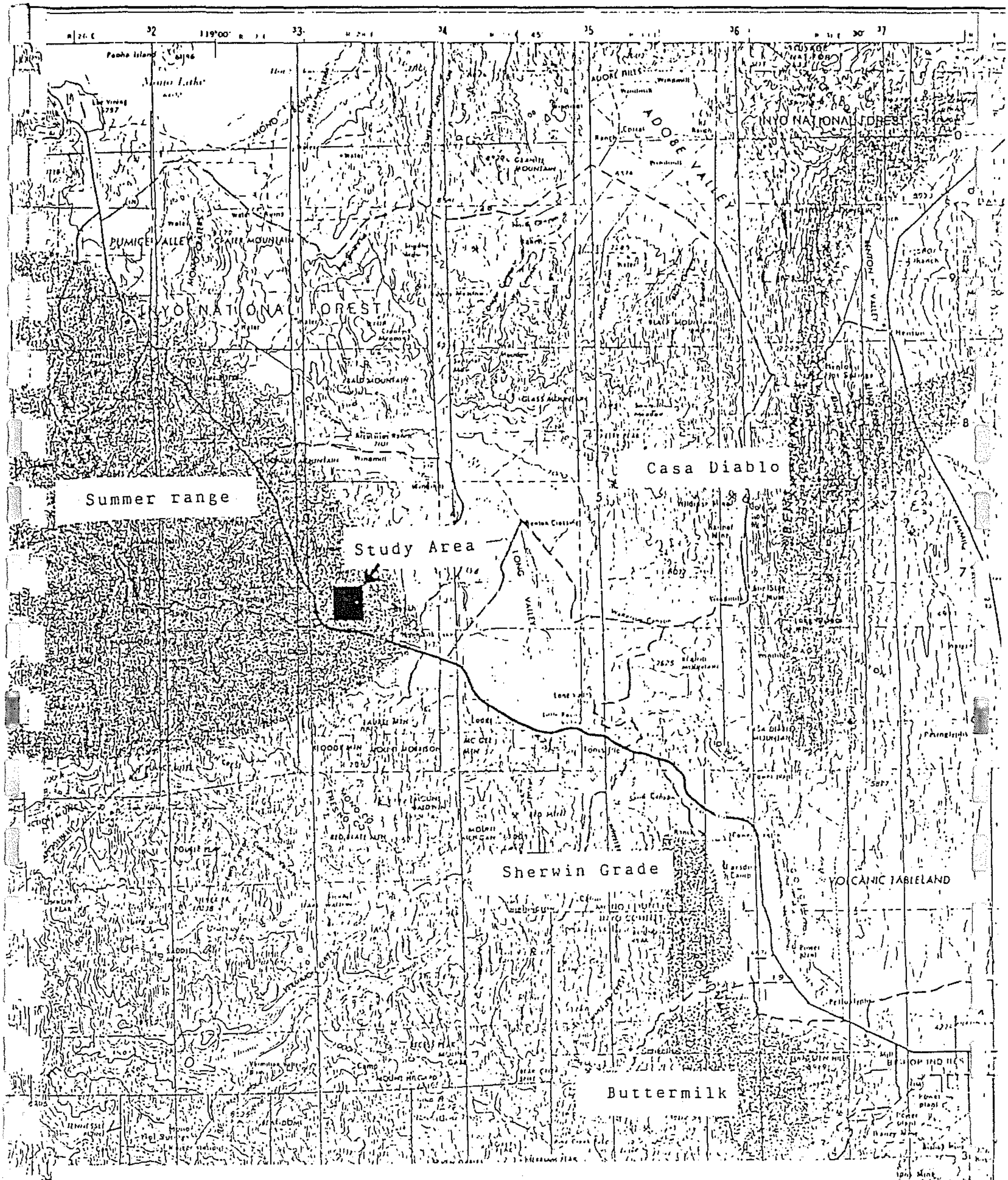

Figure 1. Regional map indicating locations of Buttermilk, Sherwin Grade and Casa Diablo Winter ranges, and approximate summer ranges of deer using the Long Valley area on migration.

conditions in the Study Area, and to assist in assessing impacts to deer of a geothermal development and designing measures to reduce those impacts.

ACKNOWLEDGMENTS

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The data in this report are to be used solely for the purposes of planning and analyzing potential environmental impacts of the proposed Casa Diablo Geothermal Project, and are not for publication, citation, or other use without the permission of the author.

STUDY AREA

The Casa Diablo Geothermal Study Area is located in portions of Sections 29 and 32 of T. 3 S, R. 28 E, Mono County, CA (Figure 2). It is immediately north of Highway 395, approximately 3 miles east of the town of Mammoth Lakes. The land is a mixture of both public and private ownership.

METHODS

A track survey route was laid out on the dirt roads which pass through the Study Area (Figure 2). This route was divided and marked into 20 sections each 0.1 miles long except Section 1, which was 0.2 miles long. In adition, the dirt road leading from

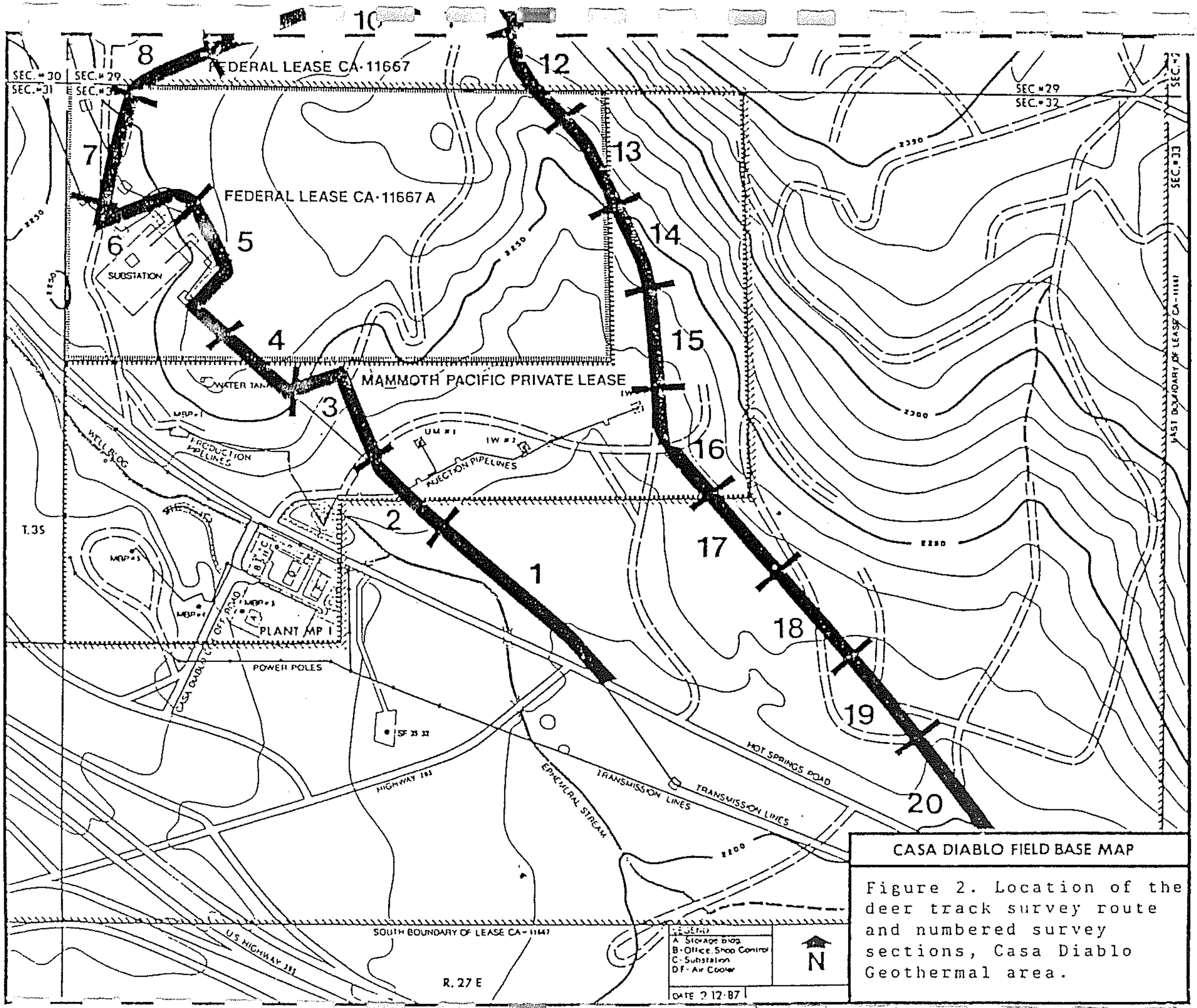


Figure 2. Location of the deer track survey route and numbered survey sections, Casa Diablo Geothermal area.

Hot Springs Road to well SF 35-32 was included in the surveys.

Beginning on 21 April 1987, the entire route was cleared of tracks and a tracking substrate prepared by dragging it with a "sled" of automobile tires pulled by a vehicle. This was done in late afternoon, and the following morning, the route was walked or driven and all deer tracks observed on the road were counted, both by survey section and by direction of travel. Data recorded were the number of individual deer making the observed tracks and their direction of travel. Because the route was dragged each evening before a survey to obliterate all tracks, the tracks counted on the surveys were made by animals within approximately the previous 12-18 hours. Recording tracks by survey section was designed to give a quantitative picture of the local pattern of deer movement in the Study Area. Recording tracks by direction of movement was designed to allow separation of back-and-forth or very localized movements from migrational movements.

RESULTS

1. Timing of deer activity

Figure 3 shows the total number of tracks made by individual deer throughout the period of study, presented without regard to direction of movement. A pattern of a gradual increase in the number of tracks throughout the period is apparent, with the greatest number of tracks counted, 20, on 13 June.

Figure 4 shows the breakdown of tracks counted on the surveys by direction of movement. Movements to the north and west are generally in the direction of the spring migration; those to the south and east west are opposite. Thus, subtracting the south and east-moving tracks from the north and west-moving ones,

Figure 3. Total deer tracks counted on surveys in the PLES geothermal site, Spring 1987.

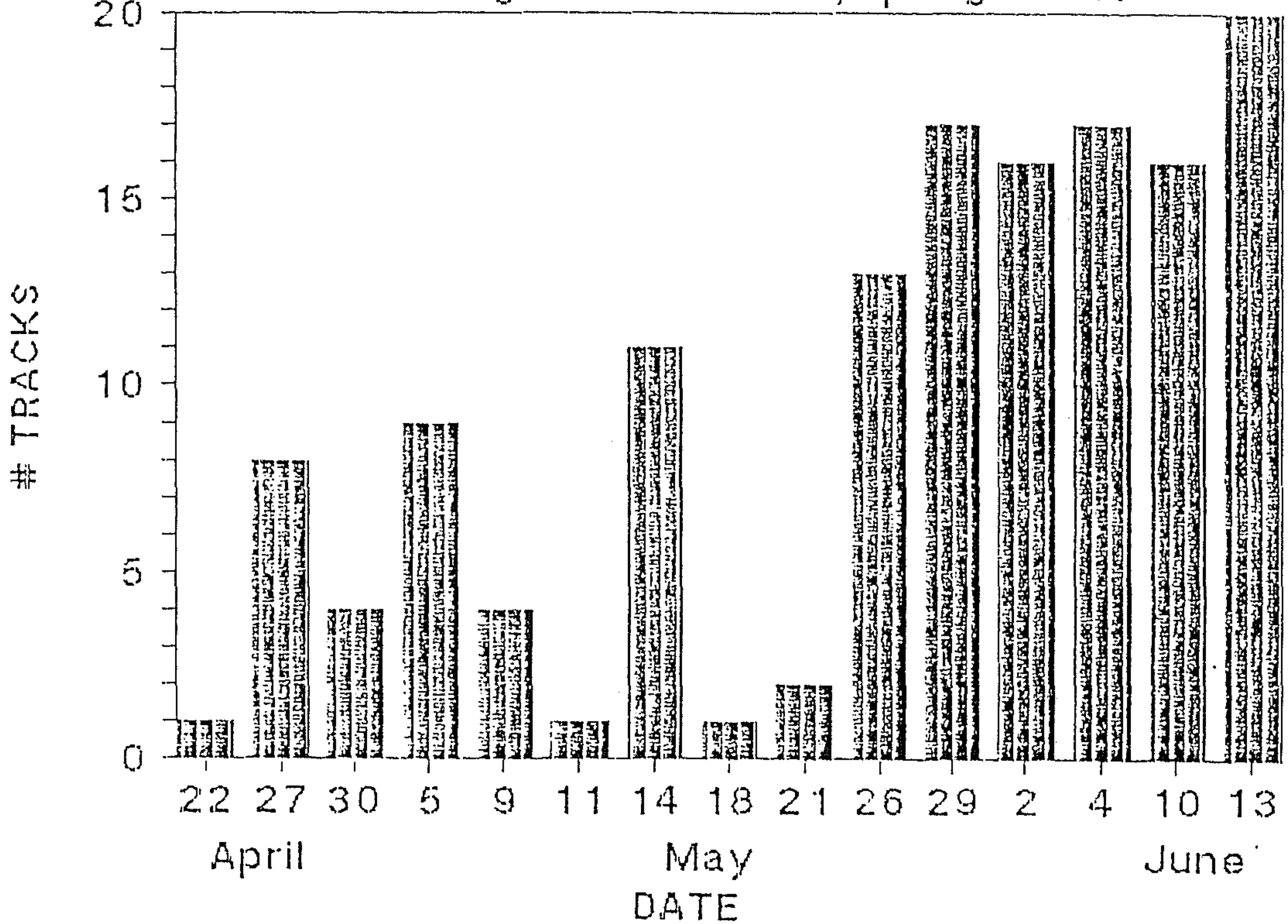
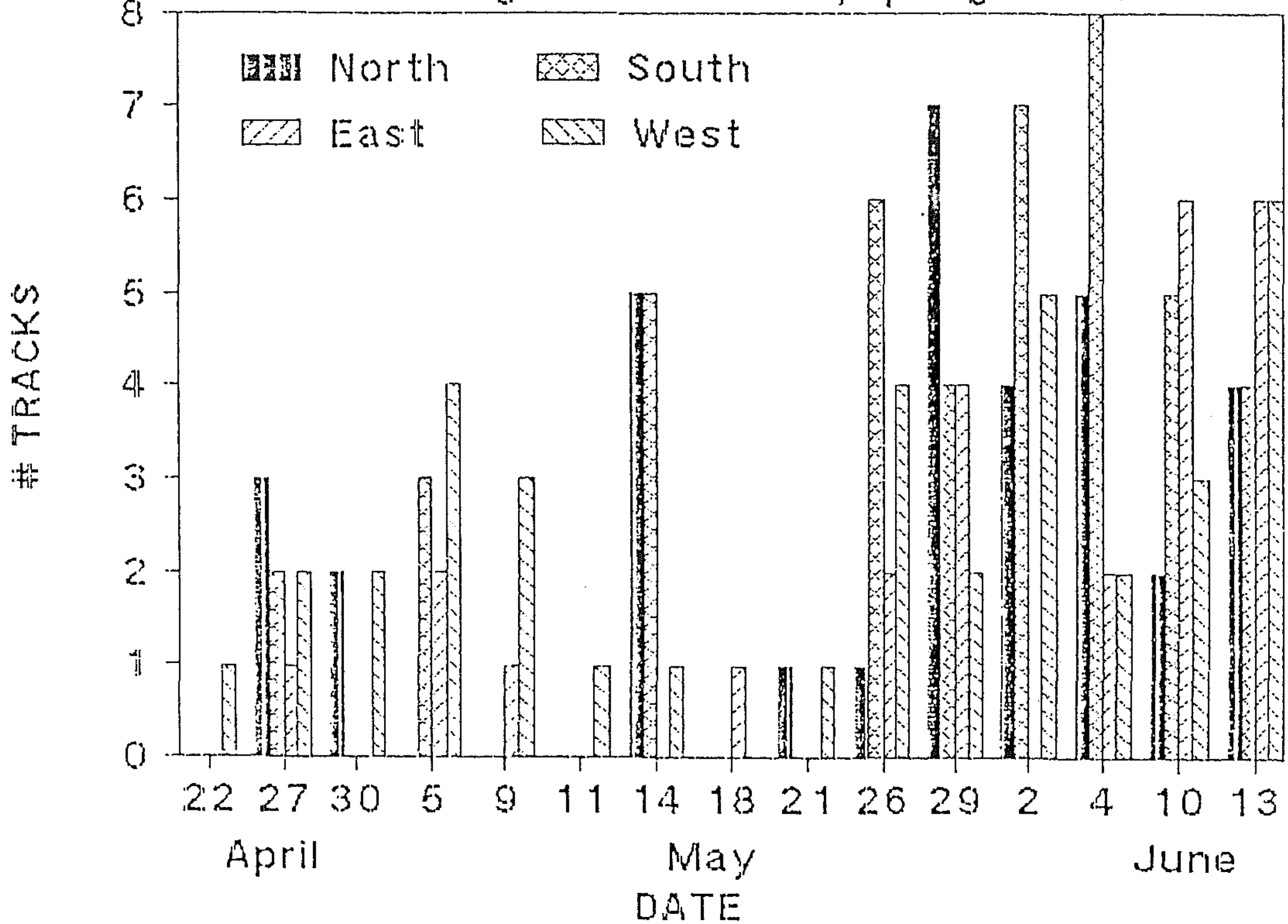


Figure 4. Deer tracks by direction of movement in the PLES geothermal site, Spring 1987.



respectively, yields a crude estimate of the net number of deer moving through between the the dragging of the route and the survey. This is shown in Figure 5, in which the number of tracks heading south was subtracted from those heading north, and the number of tracks heading east was subtracted from those heading west, on each survey. Negative numbers may be interpreted as indicating predominantly localized, nondirectional movements. As indicated in Figure 5, most migrational movements in the Study Area occurred throughout late April and May. Beginning in late May, the negative net track numbers indicate fewer directional or migrational movements and more local movements, likely from deer on what will be their summer range.

2. Locations of deer movements

Figure 6 presents the total number of deer tracks by survey section counted during the spring of 1987. The large number of tracks indicated for Section 1 is somewhat misleading because that section is twice as long as the others. With this in mind, the distribution of tracks in the survey sections appears rather uniform. The net tracks by survey section are presented in Figure 7. No consistent pattern of movements is indicated. It is apparent that directional movements occurred in Sections 8, 10-12 and 18-20, which correspond to the most northerly and northwesterly, and southwesterly portions, respectively, of the Study Area.

Additionally, on the road to well SF 35-32, single sets of west-moving tracks were observed on 10, 18, 21 and 26 May. Throughout the survey period, only two deer were observed; on 4 June, 2 adult females were seen near Sections 10 and 11. No

Figure 5. Net numbers of tracks by direction of movement in the PLES geothermal site, Spring 1987.

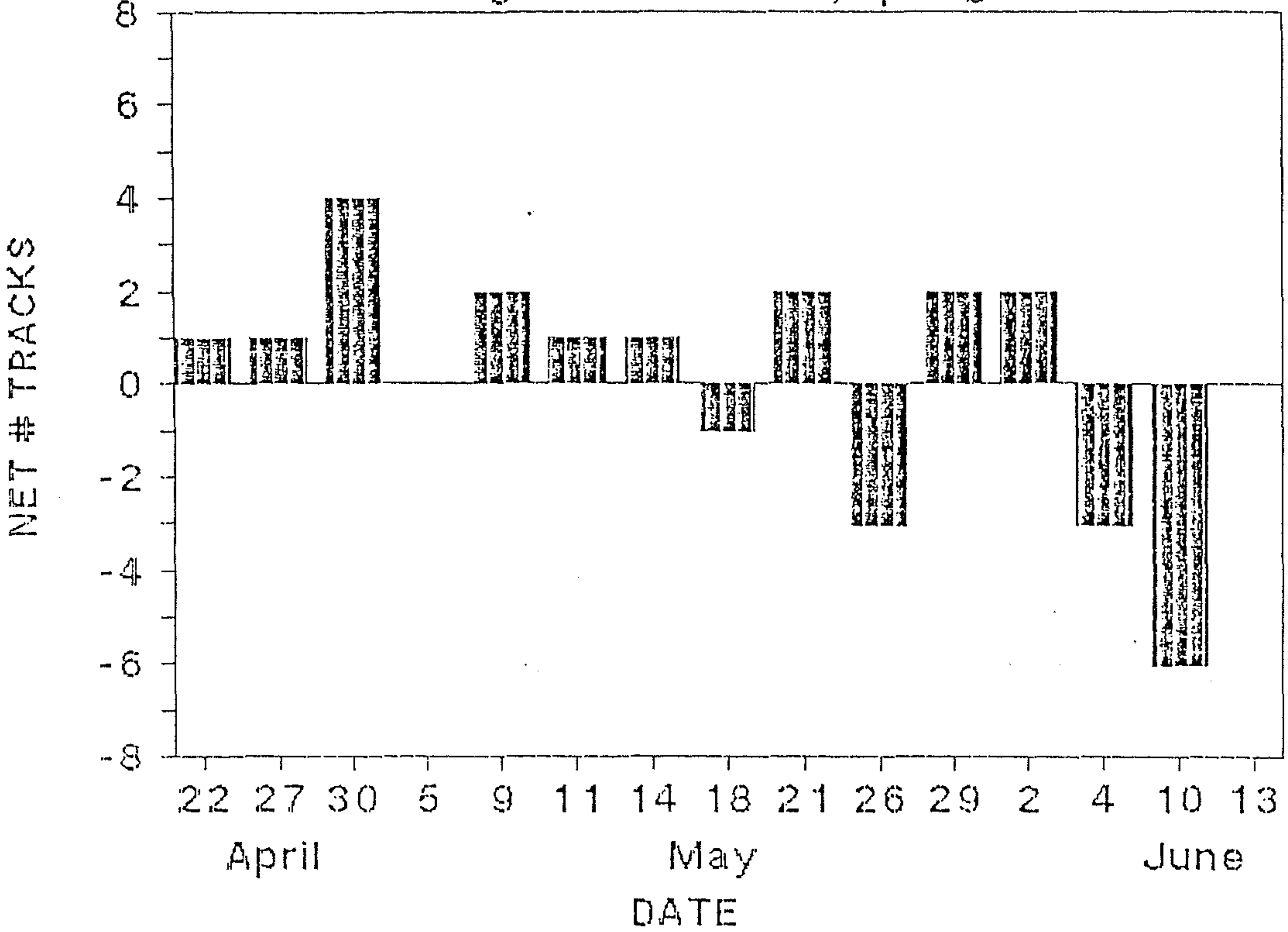


Figure 6. Total numbers of tracks counted by survey section in the PLES geothermal site, Spring 1987.

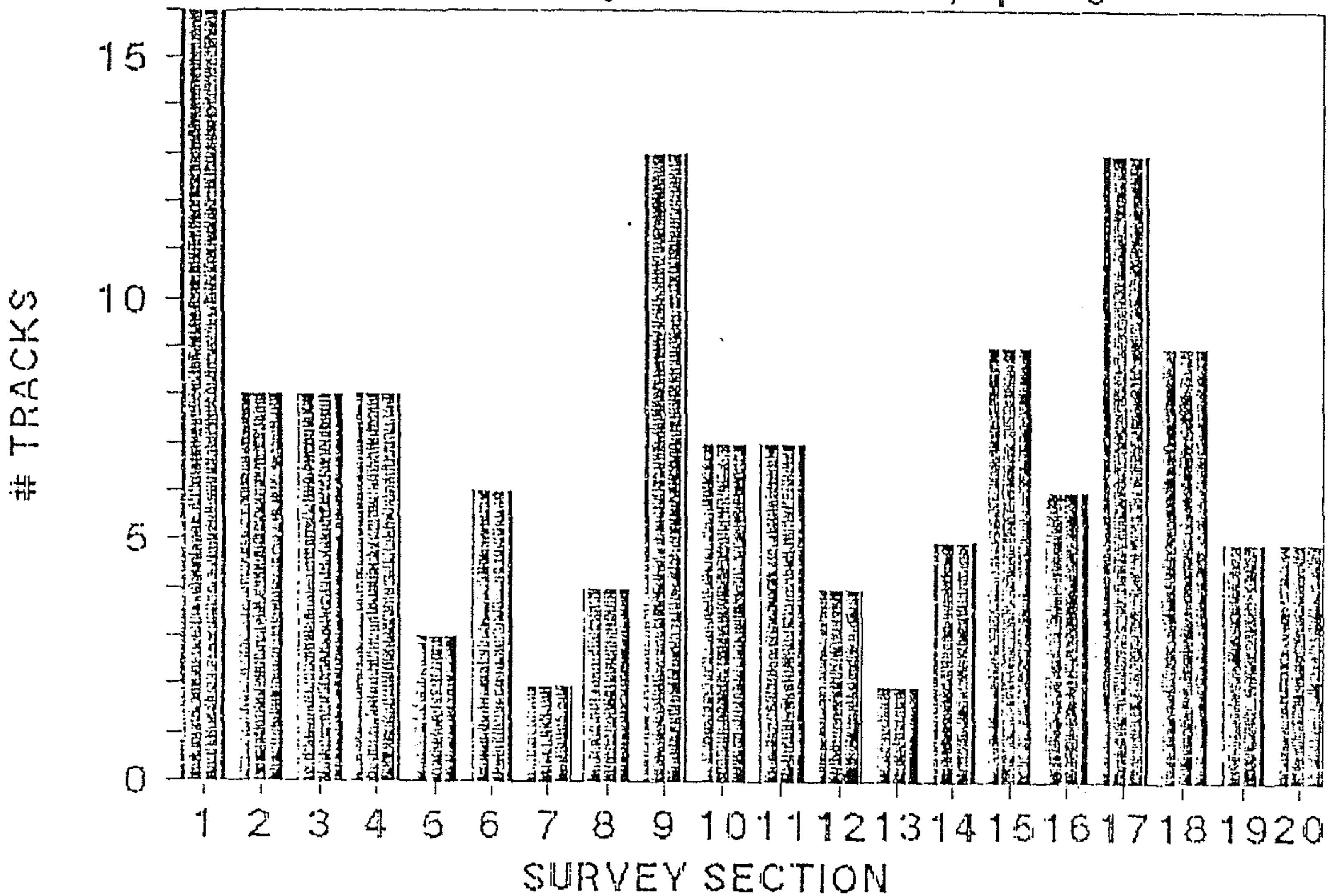
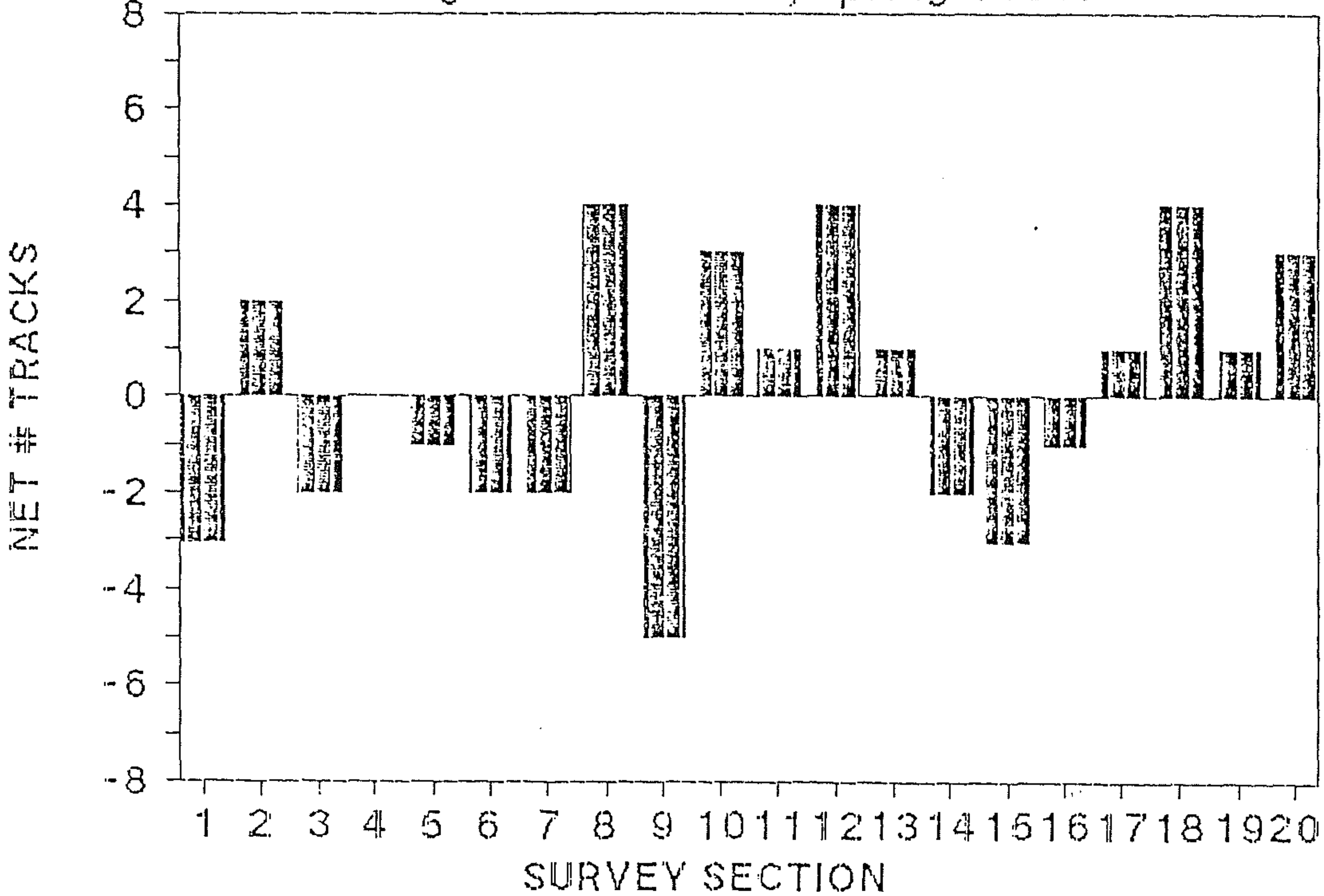


Figure 7. Net numbers of tracks by survey section, PLES geothermal site, Spring 1987.



specific areas of deer movement or well-defined concentration areas were apparent from covering the area on foot.

DISCUSSION

Results of the spring 1987 track surveys indicate a generally somewhat dispersed pattern of deer activity in and movement through the Study Area. No well-defined migration trails were observed, and the track counts indicate deer activity in all sections. One could make the rather weak case that Figure 7 shows a preference for the less developed portions of the area, i.e., Sections 8, 10-13, and 17-20, but the data are hardly compelling.

Nevertheless, deer movement through the area was apparent, and the number of animals involved can be at least roughly estimated. On the assumption that the period of spring migration was 15 April to 2 June, the 12 surveys covered approximately 25% of the 48 days in this period. The net number of tracks during this period was 13 (Figure 5). Assuming this to be a reasonable approximation of the number of deer actually moving through between the time the road was dragged and when tracks were counted the next morning, a total of 52 (13/0.25) deer moved through the Study Area during the survey period. This does not take into account those deer that may have moved through during the day. Making the assumption that 75% of deer would migrate at night (between dragging and counting) and 25% would migrate during the day, a grand total of 69 (45/0.75) deer moving through during the spring period can be estimated, given the stated assumptions.

This estimate of 69 deer is meant only as an approximation of the number of deer using the Study Area on spring migration.

Potential sources of error, e.g., multiple counts of the same animal, or tracks missed because of poor tracking medium, are impossible to quantify. However, the precise number is not important; what matters is the estimate of magnitude. There certainly are not hundreds or thousands of animals using the area, as is the case in other local areas, but likely there are dozens. This movement does not appear to be concentrated in any localized portion of the Study Area, but is dispersed throughout it, which may not be surprising given its relatively small area and lack of extreme topography. It is likely that deer from three designated "herds" are involved: the Buttermilk, Sherwin Grade, and the Casa Diablo herds. Radioed or otherwise marked deer from all three herds have been observed in the vicinity of the Study Area.

Recent radio-telemetry information indicates that, in general, most of the Buttermilk and Sherwin Grade deer which migrate north do so along the base of the mountains west of Highway 395. Likewise, most Casa Diablo deer move along the base of the Glass Mountains northwest of the Study Area. A portion of each herd, however, does move near or right through the Study Area. The specific areas used as migration corridors are probably dictated as such by both local topography and tradition.

Impacts of geothermal development on these migrating deer are difficult to predict precisely, but in a general sense are a function both of the location, amount and kinds of changes associated with the development, and of the availability of potential alternate travel routes. It seems to be the case that deer activity is rather dispersed throughout the area. The locations of the proposed project facilities (Fig. 8), including a number of proposed wells, pipelines, and a transmission line and access road, as well as the power plant site, in general are adjacent to the existing geothermal plant and facilities. Assuming a "worst case" scenario, one in which deer completely avoid the proposed facilities and associated human disturbance, it is difficult to see how making several dozen deer move several hundred yards around the facilities would constitute a great hardship. Given the existing terrain, such an avoidance would likely have a trivial impact on migrating deer. Of course, certain facilities, e.g., fences, pipelines, etc., could be designed to minimize any impacts to deer and to facilitate their passage.

From the standpoint of deer migration, the locations of the proposed facilities (Figure 8) are preferable to those of the alternate site (Figure 9). This latter alternative would move the power plant to the northeast, across Hot Springs Road, and effectively increase the area impacted by the project. In general, the more concentrated an area of disturbance, the less will be its deleterious impacts.

Thus, at present, alternate routes for spring migration exist, giving deer an opportunity to avoid the project area if developed. However, there are proposals for additional developments in the region. Although it is impossible to discuss thoroughly the impacts of a project without reference to the context in which the project occurs, a regional summary and analysis taking such additional projects into account are not within the scope of the present work. No doubt the consequences

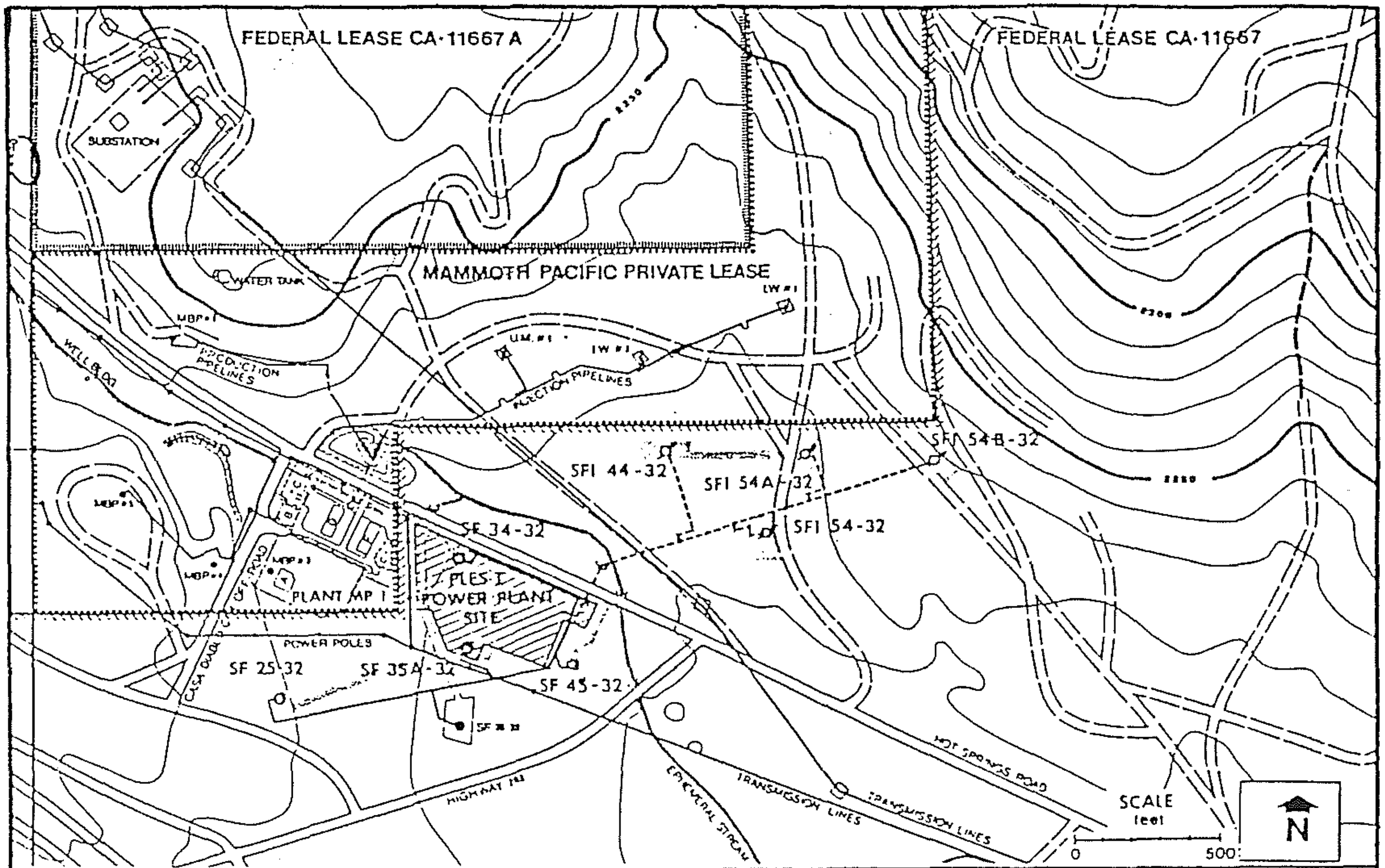


Figure 8. Proposed facilities locations, Casa Diablo Geothermal area.

O Proposed Production Well
● Existing Production Well (SF 35-32)
Proposed Injection Well
New Access Road and Well Sites
Production Pipeline
Injection Pipeline
New Electric Transmission Line

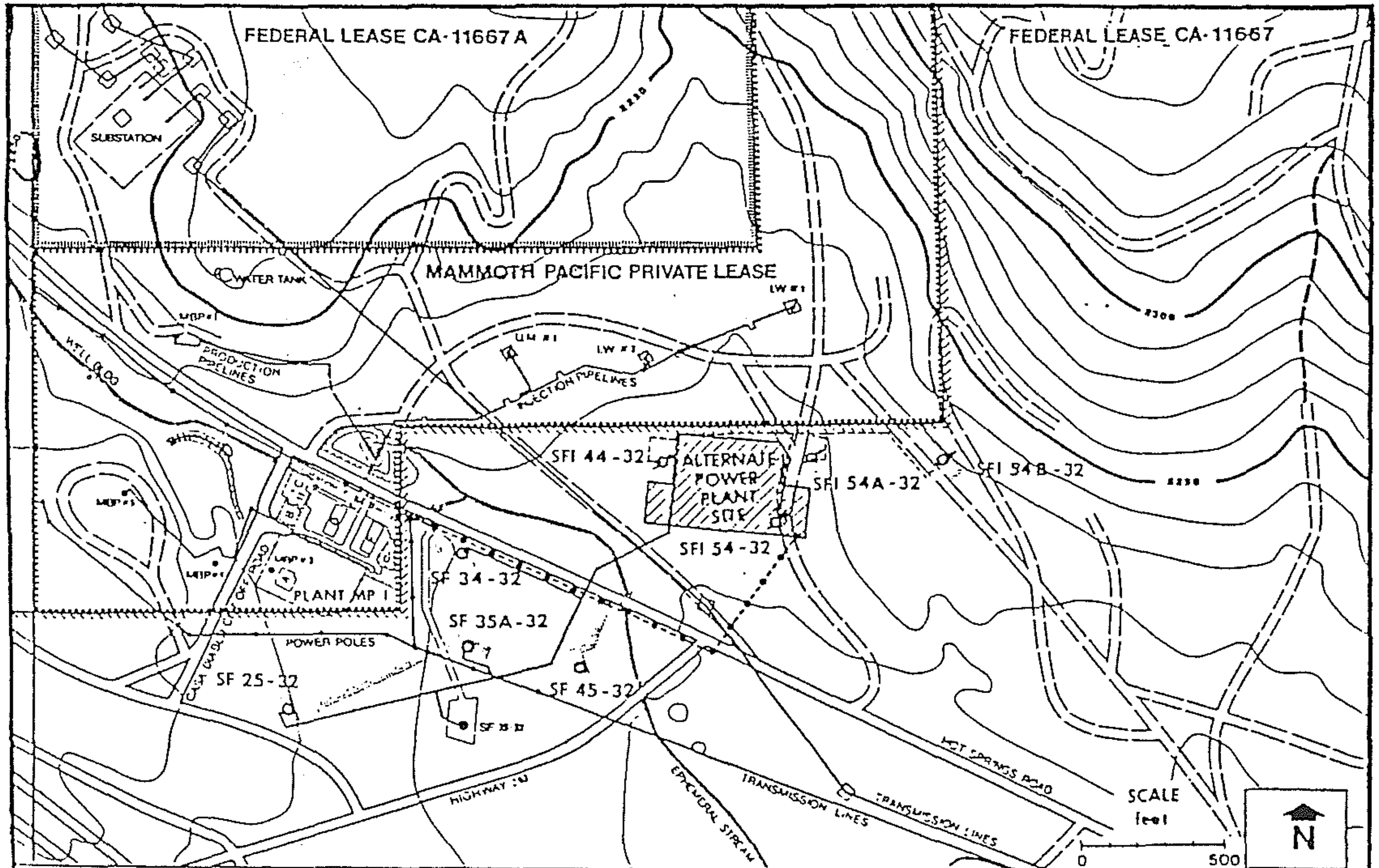


Figure 9. Alternate facilities locations, Casa Diablo Geothermal area.

- Proposed Production Well
- Existing Production Well (SF 35-32)
- Proposed Injection Well
- New Access Road and Well Sites
- Production Pipeline
- Injection Pipeline
- New Electric Transmission Line

of some of these proposed projects, because of their nature, size, and/or geographic location, are potentially much greater than those to be anticipated from Casa Diablo. Others may be more benign. A comprehensive study of the cumulative impact of potential development, however desirable from a resource management perspective, is not possible within the time constraints of this project.

The present investigation and discussion indicate that the Casa Diablo Geothermal Project, considered by itself, will likely not have a significant impact upon the spring migration. In the worst and unlikely case that deer avoid the project entirely, there are at present alternate routes available to allow migrating deer to reach their summer ranges. Thus, the Casa Diablo Geothermal Project by itself will likely have minimal negative impact.

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